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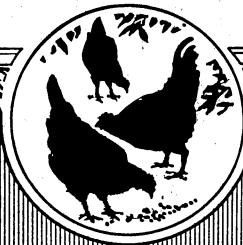
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DISEASES AND PARASITES *of* POULTRY



CHICKENS, turkeys, ducks, geese, and pigeons are susceptible to many diseases, some of which are highly infectious. Disease germs pass rapidly from bird to bird of the flock, and may be carried by one means or another to neighboring flocks, producing extensive outbreaks, or epizootics.

Poultry are also infested by numerous kinds of parasites, some of which live on the surface of the body and others internally, especially in the crop, stomach, and intestines. These parasites may seriously affect the health of the birds by preventing their nourishment and by causing irritation and inflammation of the parts which they attack.

Certain diseases respond favorably to treatment. Others resist all efforts at treatment and cause heavy losses.

Preventive measures properly applied offer the surest means of controlling diseases of domesticated birds.

The purpose of this bulletin is to inform the poultry owner as to the characteristics of the various diseases and infestations in order that he may intelligently use the most approved methods of combating them.

This bulletin is a revision of and supersedes Farmers' Bulletin 1337, Diseases of Poultry.

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DISEASES AND PARASITES OF POULTRY

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DISEASES

DOMESTIC BIRDS are subject to a considerable number of diseases, some of which spread rapidly through the flock and cause a high mortality. They may also be infested by various kinds of parasites, some of which live on the surface of the body and others in the crop, stomach, windpipe, or intestines. These parasites are injurious because they take a part of the nourishment which should

¹ The part of this bulletin that treats of bacterial diseases was revised by John S. Buckley and Hubert Bunyea and the part relating to parasites by Eloise B. Cram. F. C. Bishop, in charge of the division of insects affecting man and animals, Bureau of Entomology, assisted with the part relating to the habits and control of insects, mites, and ticks.

be used by the bird to put on flesh or to produce eggs, and also because by their movements and their biting they cause irritation and inflammation of the parts which they attack.

The contagious diseases which are caused by germs and the weakness and loss of flesh caused by the larger parasites, to which reference has just been made, are the most important conditions which the poultryman has to consider in the endeavor to keep his birds healthy. These germs and parasites should be kept out of the flock by suitable preventive measures, because disease may be avoided much more easily and cheaply than it can be cured. The aim in studying the diseases of poultry is, therefore, to learn how to prevent the diseases as well as how to cure them.

HOW TO PREVENT DISEASE

Precautionary methods will do much to keep birds free from disease, since infections gain entrance to the flock through the introduction of new birds from infected flocks, exposure at poultry shows, or contact with fowls which are diseased. Infection may also be carried to premises on the shoes of man or feet of animals. Free-flying birds are apparently responsible for the spread of disease in some cases. Poultry keepers should quarantine newly procured fowls or show birds for two to four weeks, in order to allow symptoms of any disease, which may be carried, to develop.

The greater the number of birds kept on any farm or plot of ground and the more they are crowded together the greater is the danger from contagion and parasites and the more important are the measures of prevention and eradication.

HOW TO CONTROL DISEASE

As a rule, when a bird becomes sick the best policy is to kill it, for the reason that it may be affected by a contagious disease which, before it is recognized, may spread to many others in the flock. Also, if the poultry owner attempts to treat such birds, there is great danger of carrying infection from the sick to the healthy in handling or feeding. If a disease becomes established in the flock, however, a line of treatment should be undertaken. In some diseases, such as cholera and the choleralike diseases, fowl typhoid, tuberculosis, and aspergillosis, treatment of affected birds is of little value, and preventive sanitary measures must be depended on to keep infection as low as possible.

The treatments recommended in this bulletin are in accordance with the best present knowledge of the subject. However, methods of controlling certain diseases are not yet based on experimental procedure, but investigations to obtain such scientific information are in progress.

In controlling outbreaks of infectious diseases the first effort should be to separate the sick from the healthy birds as soon as symptoms become noticeable. The droppings should be removed from the houses daily and placed where the fowls will not have access to them. The houses and all feeding and drinking utensils should be frequently cleaned and disinfected. The use of permanganate of potash in the drinking water assists in preventing the spread of

infection by means of the water, but the efficacy of the drug is destroyed by gross pollution of the water by organic matter, such as bowel discharges. The proportion is one-third teaspoonful of permanganate to the gallon of drinking water. This solution is anti-septic only so long as it retains a deep, purple color. It is also advisable to give the entire flock a dose of Epsom salt in the proportion of one-half teaspoonful to the adult fowl. The salt may be dissolved in hot water and mixed in a sufficient quantity of mash for one feeding.

DISINFECTANTS AND THEIR APPLICATION²

Good disinfectants destroy the germs of contagious diseases, the external parasites, such as lice and mites, and in some cases the eggs of parasitic worms. Since the germicidal power of disinfecting solutions is rapidly spent by contact with organic matter it is always important to give special attention to the cleaning of the premises, including the removal of all litter, contaminated soil, manure, etc., before applying the disinfecting solution. The disinfectants should be thoroughly applied to the interior of the houses, worked into all the cracks and crevices, spread over the ceiling and the floor, the roosts, dropping boards, and nest boxes. At the same time the feeding and drinking troughs should be disinfected by pouring boiling water into them and afterwards drying them in the sun. Disinfectants are most easily applied to the walls and ceilings with a spray pump or with a brush. As it is difficult to keep them from coming into contact with the face and hands, the more harmless of these mixtures should generally be used. Ordinarily limewash made from freshly slaked lime is excellent, and its properties are well known. In the case of an actual outbreak of virulent disease it is well to add to the limewash 6 ounces of chlorinated lime to each gallon to increase its activity as a disinfectant.

Metallic fixtures, such as galvanized metal nest boxes, feed hoppers, and drinking fountains, should be taken out, cleansed, and scalded, as it is not advisable to apply the chloride-of-lime wash to metal surfaces, on account of its corrosive action.

The kerosene emulsion, which is frequently used to destroy mites, may readily be converted into a disinfectant. To make the emulsion, shave half a pound of hard laundry soap into half a gallon of soft water and boil the mixture until all the soap is dissolved, then remove it to a safe distance from the fire and stir into it at once, while still hot, 2 gallons of kerosene. This makes a thick, creamy emulsion or stock mixture. When it is to be used for killing mites in the houses, 1 quart of this emulsion is mixed with 10 quarts of water. When it is to be used as a disinfectant, stir well, then add 1 pint of crude carbolic acid or crude cresol, and again stir until all is well mixed.

The compound solution of cresol is one of the best disinfectants and may be purchased ready for use. It contains 50 per cent of cresol. One-half pint of it added to 8 quarts of soft water makes a solution of proper strength to apply to the poultry house and its equipment for the destruction of most of the disease-producing bac-

² Additional information on the disinfection of poultry houses is contained in Farmers' Bulletin 954, The Disinfection of Stables, which may be obtained from the Office of Information, United States Department of Agriculture, Washington, D. C.

teria. A 5 per cent solution of carbolic acid (1 pint of carbolic acid to 10 quarts of water) is about equally efficacious. The choice between the two is a matter of convenience.

The disinfection of soil in poultry runs is not entirely practicable, but when the runs are regarded as heavily contaminated with disease germs, or infested with the eggs of poultry parasites, much added protection can doubtless be given the flock by scaling off the surface of the run to a depth of 4 inches or else liming it and spading or plowing it under to a good depth.

SIMPLE CATARRH (COLDS)

Simple catarrh is a mild inflammation of the nasal passages, and is common to all kinds of domesticated birds.

Cause.—No definite cause may be assigned to this affection. It has been asserted that weak or improperly nourished birds are more likely to be attacked than strong, vigorous, well-nourished individuals. Exposure to unfavorable conditions, in which rain, dampness, and cold drafts tend to lessen the resistance of the mucous membranes of the nostrils to the various organisms normally present there, has been held to be the primary contributing cause.

Symptoms.—The affected bird is more or less dull in appearance, according to the severity of the attack. The appetite is diminished, breathing becomes difficult, and a watery discharge from one or both nostrils is early in evidence. This discharge may disappear in from two to four days, or it may take on a viscid consistency, closing the nasal openings and necessitating breathing through the mouth.

Treatment.—As the disease is of short duration, it is usually necessary only to place the patient under more favorable conditions to bring about recovery. In the more severe cases the nostrils should be washed out twice daily with boric acid in 3 per cent solution, or permanganate of potash, 1 dram (about a teaspoonful) to a pint of water.

CONTAGIOUS CATARRH (ROUP)

Contagious catarrh, or roup, attacks principally the membranes covering the eye, in the sacs below the eye (infraorbital sinuses), the nostrils, and the windpipe. (Fig. 1.)

Cause.—The nature of the microbe which constitutes the virus of roup is not known. The contagion is generally brought into the poultry yard by infected birds. Sometimes they are birds which are purchased from other flocks in which the disease exists; sometimes they are birds of the home flock which have been in exhibitions and there exposed to sick fowls; and sometimes they are wild birds or pigeons which fly from one poultry yard to another.

The saliva and the discharge which escapes from the nostrils carry the contagion and soon contaminate the drinking water and feeding troughs, so that all the fowls are exposed to infection. Even the flocks in adjoining yards are infected by the particles of mucus projected into the air when sneezing, or by the contagion carried on the feet of persons, animals, or small birds that pass from one yard to another. Exposure to cold, dampness, and drafts aids in the development of roup.

Symptoms.—The symptoms first seen are very similar to those of an ordinary cold, but there is more fever, dullness, and prostration. The discharge from the nasal openings is at first thin and watery, but in two or three days it becomes thick and has an offensive odor. The inflammation, which begins in the nasal passages, soon extends to the eyes and to the spaces immediately below the eyeballs, causing the formation of swellings which may reach the size of a hickory nut. The resulting pressure sometimes destroys the eye, or causes permanent loss of vision. The eyelids are swollen, held closed much of the time, and may be glued together by the accumulated secretion. The closing of the eyes prevents the badly affected birds from finding food. The accumulation of mucus in the nostrils completely obstructs these passages so that the beak must be kept open to permit the bird to breathe. The obstruction of the windpipe and of the smaller air tubes causes loud breathing sounds and difficult respiration. In the severe and advanced cases the birds sit in a somnolent or semiconscious condition, unable to see or to eat; their strength is rapidly exhausted, and many of them die within a week or 10 days. Some of the affected birds recover, but others remain weak and have a chronic form of the disease for months, during which time they continue to disseminate the contagion.

This disease is distinguished from diphtheria (chicken pox) by the absence of the thick, tough, and very adherent cheesy exudates in the mouth and throat which are characteristic of the latter disease. Sometimes there may be a deposit of yellowish material on the walls of the mouth and throat, but it is easily broken up and removed. There are no warts on the comb, face, or wattles.

If mouth breathing is long continued, it eventually brings about a horny, dried condition of the tip of the tongue, commonly referred to as "pip," unless that is properly prevented by anointing the tongue with petrolatum or a bland oil.

Treatment.—The sick birds should be removed from the flock and put in a warm, dry, well-ventilated room free from drafts. The affected mucous membranes of the nostrils and mouth should then be treated with antiseptic solutions. The best method is to use a good spraying apparatus, but, lacking this, a small syringe, an oil can, or even a medicine dropper can be made to answer the purpose, or the bird's head may be plunged into a basin or bowl of the solution and held there a few seconds, but not long enough to cause suffocation.

The antiseptics most suitable for such treatment are: Boric acid 1 ounce, water 1 quart; or permanganate of potash 2 drams, water 1 pint; or peroxide of hydrogen 1 ounce, water 3 ounces. Where the inflammation has progressed to the eye, excellent results have fol-



FIGURE 1.—Head of fowl affected with contagious catarrh (roup), showing swelling of the eye

lowed the use of argyrol. One or two drops of a 15 per cent solution are introduced between the eyelids twice daily for several days.

Before applying these substances it is well to wash the eyes and mouth with warm water containing 1 teaspoonful of common salt to a quart, using a pledge of absorbent cotton and rubbing gently, at the same time pressing and massaging about the nostrils and under the eyes to loosen the accumulated secretion. If there is a swelling under the eye, it should be carefully opened with a sharp, clean knife, all the excretion removed, and the cavity washed with one of the above-mentioned solutions. A pledge of cotton moistened with the solution may be left in the opening for an hour or two.

Various types of germs have been observed as secondary invaders in the eye exudates of roup. Autogenous bacterins made from these germs may be of value in protecting the flock in question from the spread of roup. The bacterins may be obtained from any biological laboratory by submitting specimen birds affected with the disease. Stock bacterins prepared from avian strains of *Staphylococcus aureus* have also been used with good results in the prevention and treatment of roup.

The houses should be kept clean and dry and occasionally disinfected. If the disease is of a severe type, it is often better to kill the affected birds. This radical method avoids the retention of birds which may harbor the contagion and cause the development of subsequent outbreaks.

NUTRITIONAL ROUP

This is a disease of the eyes of growing chicks resembling roup in appearance but due to the deficiency of fat-soluble vitamin A in the ration.

This food element is obtainable from many sources, such as cod-liver oil, butterfat, green feeds, raw carrots, tomatoes, and egg yolks. On being supplied with feeds containing vitamin A in sufficient quantities fowls affected with nutritional roup usually recover.

CHICKEN POX (DIPHTHERIA)

Chicken pox and diphtheria were originally thought to be separate diseases. It was discovered later that the virus which causes the formation of warts or pox nodules on the head, typical of chicken pox, also causes the cheesy patches in the mouth and eyes which are characteristic of diphtheria. Since the symptoms of chicken pox and diphtheria are but external and internal manifestations, respectively, of the same disease, the two conditions are now combined and described as chicken pox. Chickens and pigeons are most frequently affected, but turkeys and birds generally are susceptible.

Cause.—Chicken pox is caused by a virus which passes through laboratory filters and can not be seen under the microscope. The disease is strictly infectious and never develops as a result of exposure to dampness and drafts alone, although these conditions favor its spread and tend to increase its malignancy. The contagion is introduced and disseminated in a flock in the same manner as in roup. It is quite probable that biting insects, such as mites, also spread infection through inoculation from sick to healthy birds.

Symptoms.—The disease has the general symptoms of roup but is distinguished from the latter by an eruption of pox nodules on the head and by the presence, in the mouth, throat, and eyes, of tough, cheesy patches which are firmly attached to the tissues beneath them. (Figs. 2 and 3.)

The eruption appears as round, oblong, or irregularly shaped nodules from the size of a pinhead to that of a pea or a hazelnut. It is seen especially about the beak and nostrils and on the comb, the eyelids, the wattles, and the ear lobes. In some individuals, and particularly in pigeons, the eruption is more generalized and is found on the skin of other parts of the body, as the neck, under the wings, on the rump, and about the vent. Here the nodules may become larger than on the head. The nodules begin as small, red, or reddish-gray growths with a shiny surface and gradually enlarge, while the color changes to a yellowish, brownish, or dark brown, and the surface dries and becomes shriveled, uneven, and warty in appearance. Owing to the number of nodules and the extension of the inflammation, large patches of skin become thickened and covered with hard, dry crusts, closing the nasal openings or the eyelids, and making it difficult even to open the beak.

The severity of the disease depends much on the extent of the internal diphtheritic deposits. These are at first thin, yellowish or whitish in color, and gradually become thicker, firmer, and more adherent, so that considerable force is required to remove them.

The mucous membrane beneath the deposit, when the latter is removed, is found to be inflamed, ulcerated, and bleeding, but it is soon covered by a new deposit. This exudate is called a false membrane, and when it is situated where the breathed air passes over it, it dries, becomes uneven and fissured, and its color changes to a dark brown. In pigeons the exudate is more friable and easily removed, and the mucous membrane beneath it is reddened but not ulcerated.

While the false membranes over the parts first affected are becoming thicker, the inflammation extends to the adjoining surfaces, and new diphtheritic centers develop, uniting with one another until the cheeks, tongue, palate, throat, and inside of the nostrils are covered. Very often the inflammation extends from the nostrils to the eyes, and sometimes it penetrates the air tubes to the lungs, or the gullet to the crop. When false membranes form in the gullet, crop, and intestines there is a rapid aggravation of the symptoms, as intense



FIGURE 2.—Chicken-pox nodules on comb, on wattles, and near corner of mouth. (After Hufnagel and Marek)

diarrhea, and the escape of blood with the droppings. This type of the disease is more frequent in waterfowl than in other birds. Some fowls in a flock are resistant, and after a few days of illness rapidly recover. Others remain dull, weak, and thin in flesh, and may have more or less catarrh and difficulty of breathing for a long time.

The period between exposure to the contagion and the appearance of the first symptoms varies from 3 to 15 days. The duration of the disease varies from two or three days to as many weeks in the acute cases, while the chronic form may continue for several months.

Treatment.—The treatment of fowls *severely* affected with diphtheria requires much time and patience, and as a rule does not pay. It is often better to kill the birds, bury or burn their carcasses, disinfect the poultry houses, and in that way eradicate the contagion as soon as possible.



FIGURE 3.—Fowl diphtheria. Neck slit open to show diphtheritic patches in mouth and esophagus. (After Kätz)

solution of carbolic acid and apply it for a moment or two to the diseased surface. Another solution which may be used is made by dissolving 2 drams of permanganate of potash in a pint of water. A very good solution consists of 1½ ounces of boric acid and 1 ounce of powdered borax (borate of soda) dissolved in 1 quart of water and applied warm. The two last-mentioned solutions may be used to wash the eyes or may be injected into the nostrils. Argyrol may also be used as recommended in contagious catarrh. If large swellings appear beneath the eyes they should be opened with a clean, sharp knife, the contents of the cavity removed, and the space frequently washed with the boric-acid-borax or permanganate-of-potash solution mentioned above.

The external lesions of this disease may be treated successfully by simple local applications. The crusts on the nodules are softened with carbolated ointment, glycerin, or oil, and after an hour or two removed by washing with warm water containing a little soap. The denuded tissue is then treated with a 5 per cent solution of carbolic acid or with tincture of iodine.

If it is decided to treat the sick birds they should be removed from the flock and put into a comfortable, well-ventilated room that may be easily disinfected. Make a solution by dissolving 2 drams of common salt in a quart of warm water, and with a soft brush or a pledge of absorbent cotton dipped in this solution gently brush or rub the false membranes until they are disintegrated and loosened from the underlying tissues. Sometimes it is necessary to scrape them off with a spoon or knife, but it must be done carefully, so that bleeding will not be caused or the sensitive tissues injured. After the false membranes are removed, wet a pledge of absorbent cotton in tincture of iodine or in a 5 per cent

As this disease is contagious, the houses, drinking vessels, and feed troughs should be kept disinfected during the outbreak and for several days after all the birds have apparently recovered. The drinking water is made antiseptic by dissolving one-third teaspoonful of permanganate of potash in each gallon.

Chicken-pox vaccine is used for the prevention of the disease. Its results are variable. In some cases it appears to prevent or lessen the severity of outbreaks, while in others no benefit seems to be derived from its use.

More uniformly successful results are obtained with the cutaneous vaccination method, which has been in use for several years. This procedure consists in plucking away several feathers from the front part of one leg, and, with a cropped, camel's-hair brush, or other suitable applicator, rubbing the vaccine into the disrupted feather follicles. Various modifications of this method have been indorsed by European and American investigators.

INFECTIOUS BRONCHITIS

Synonyms: Influenza, "flu," infectious tracheobronchitis.

Infectious bronchitis is observed among chickens during the fall and winter months, especially in the large, central poultry-feeding establishments of the Middle West, and during shipment of the fowls by rail to the principal poultry markets.

Cause.—The disease is caused by the presence of an infective agent the nature of which is not known.

Symptoms.—Difficulty in breathing causes the bird to extend the head and open the beak for each respiration (fig. 4), and there is usually a rattling noise caused by obstruction of the windpipe. The bird becomes ruffled and unkempt. The facial expression is distressed. Appetite rapidly diminishes. Sticky exudates in many cases are present in the mouth and nasal cavity.

Affected birds may recover. Many cases, however, die in 3 or 4 days after exposure, or may succumb after a week or 10 days. Death is apparently caused by asphyxiation from the mechanical obstruction of the windpipe with dry, cheesy exudates. These are more darkened and fibrinous than those of avian diphtheria, and are found only in the air passages.

Post-mortem appearance.—Autopsy reveals no significant lesions except an inflammation of the nasal tract and windpipe, which are obstructed with a mucopurulent or fibrinous exudate, frequently tinged with blood. Some cases show pneumonia but they are the exception, and may represent the more chronic form of the disease.

Treatment and prevention.—No satisfactory flock treatment is known. Individual cases have been benefited by the repeated removal of the dried exudative plug from the windpipe, and requir-

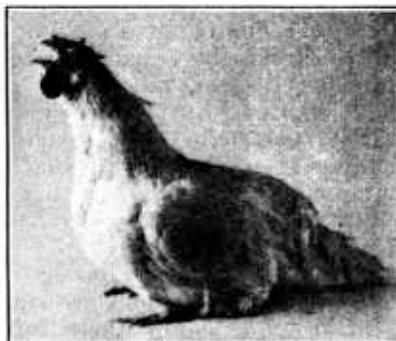


FIGURE 4.—Hen affected with infectious bronchitis, showing typical appearance due to difficult breathing. (Photo by J. R. Beach)

ing the bird to take, by the mouth, daily a gelatin capsule containing 3 drops each of beechwood creosote and oil of eucalyptus and from 6 to 8 drops of castor oil or sweet oil.

Prevention is favored by the application of rigid sanitary measures, such as cleaning and disinfecting the premises, isolating all sick birds, burying or burning all carcasses, and providing comfortable, spacious, and correctly ventilated quarters for the flock.

WHITE DIARRHEA OF CHICKS

White diarrhea is a commonly used term which covers the various diseases of chicks from the time of hatching until the birds are approximately 1 month old. It merely indicates a common symptom, a whitish diarrhea, which is usually observed in sick chicks, no matter what the specific nature of the disease may be.

Cause.—There are four important infectious diseases of fowls which affect baby chicks and induce a whitish diarrhea. These are pullorum disease, coccidiosis, aspergillosis or brooder pneumonia, and cholera. It is necessary that these diseases be discussed separately, as their causes, modes of infection, treatment, and the methods for their control differ. They are described under the foregoing names elsewhere in this bulletin. Other conditions, such as faulty regulation of brooder heat and feeding, may cause symptoms of white diarrhea.

Symptoms.—The symptoms in the different diseases which cause white diarrhea of chicks are similar and will be given here in order to make unnecessary their repetition under each of the diseases referred to above.

Pullorum disease or bacillary white diarrhea caused by *Salmonella pullorum* infection is observed in chicks from the time of hatching until they are three weeks old. The other three diseases may occur during the first three weeks or later. The chicks may die suddenly after having shown but slight symptoms for a short time. Generally, however, there is first observed a disposition to huddle together and to remain under the hover or under the hen more than young chicks should. Very soon they appear listless, stupid, sleepy, and indifferent to what is going on about them. They stand in one position or sit still with the eyes closed, and the few efforts which they make to pick up feed appear mechanical and unsuccessful. Their plumage loses its luster, the wings droop or project slightly from the body, and the characteristic diarrhea soon appears. The droppings may be white and creamy, mucilaginous and glairy, or they may be mixed with a brownish material. Often the sticky excrement adheres to the down about the vent, dries, and continues to accumulate until it completely covers and plugs the opening. This condition, known as "pasting up behind," unless soon relieved will cause the early death of the chick. Many of the diseased chicks chirp or peep almost constantly, and when attempting to void the excrement they may give utterance to a shrill cry, as if the effort brought on paroxysms of pain. As death approaches the breathing becomes labored and the abdomen heaves with each breath. Toward the last the strength is completely exhausted and the chick sits constantly or lies on the side with outstretched wings until it dies. (Fig. 5). The most prominent and characteristic symptoms in nearly all

cases are the white diarrheal discharges and the rapid wasting away of the affected birds. When infection is present, the losses vary from 50 to 80 per cent of the chicks hatched. Sometimes it is impossible to raise any of them.

Post-mortem appearance.—In white diarrhea caused by *S. pullorum* the lungs and heart may show small necrotic spots. In coccidiosis the ceca or blind pouches of the intestine are usually distended with necrotic or bloody material. In aspergillosis of baby chicks the lungs and air sacs are the seat of moldy growths.

Treatment.—Medical treatment of affected chicks is impracticable except in coccidiosis, as it has very little effect on the course of the disease. The birds may be given sour milk or buttermilk to drink.

For further information on the above-mentioned diseases the reader is referred to the portions of this bulletin dealing with pullorum disease, coccidiosis, brooder pneumonia, and cholera.

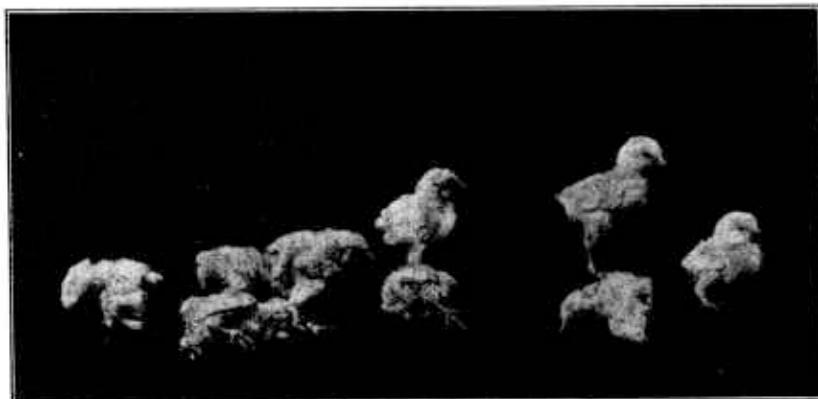


FIGURE 5.—Chicks affected with white diarrhea

PULLORUM DISEASE OF FOWLS AND CHICKS

The microorganism known as *S. pullorum* causes a disease in hens which is generally confined to the ovary. This infection is widespread in the United States and is responsible for enormous losses through its spread by means of the egg to baby chicks, causing pullorum disease or "bacillary white diarrhea."

Cause.—Chicks which recover from bacillary white diarrhea frequently retain the causative organism, *S. pullorum*, in their bodies, where it later localizes in the active ovary. The disease may be contracted also by feeding with fowls that harbor the organism or by eating infected eggs. In some cases from 50 to 70 per cent of a flock of hens may be affected. Many of the eggs laid by these hens carry the microorganism, and chicks hatched from them spread the disease to others of the brood. Chicks are highly susceptible to infection during the first 48 hours of life, but are practically insusceptible after the fifth day. Many of the exposed chicks become infected and the death rate may reach 100 per cent.

Another source of infection is through incubators and brooders which have previously held diseased chicks. It has recently been shown by scientific experiments that pullorum disease may be trans-

mitted from diseased chicks to healthy ones by exposure in an incubator for from 18 to 24 hours from the time of hatching, without actual contact between the chicks. A large percentage of chicks so exposed may succumb to the disease even under the most favorable subsequent brooding conditions. Day-old chicks from infected flocks may carry infection to other points and contaminate incubators or brooders or infect other flocks.

Symptoms.—In acute outbreaks or in experimental infection the hen becomes droopy, the feathers ruffled, the comb and wattles pale, and the head drawn back. There is loss of appetite, and diarrhea is often in evidence. Death follows in from one to several days. In the ordinary form of the disease, however, no external symptoms are observed, and it is only through the presence of pullorum disease in the chicks or the detection of diseased ovaries in slaughtered hens that attention is directed to the presence of the disease in a flock.



FIGURE 6.—*a*, Normal ovary of fowl; *b*, ovary affected with *Salmonella pullorum*. (After Rettger)

presence of the disease in a flock may be detected by post-mortem examination, by laboratory methods, or by other special tests.

Prevention.—The nature of the affection renders treatment futile. Flocks which harbor the infection should not be used for breeding purposes. The cycle of infection established by the hen, the egg, the recovered baby chick, and the pullet indicates that it is not advisable to save for breeders any chicks which have been exposed to an outbreak of white diarrhea. Hens which harbor the infection in their ovaries are likely to lay infected eggs from which diseased chicks will be hatched. The most practicable means of controlling

In baby chicks infected in the egg symptoms appear immediately after hatching or in a day or so. Chicks which contract the disease after hatching show symptoms in from 4 to 10 days later. Deaths occur from the time of hatching until about three weeks later, when the brood may be practically wiped out. For symptoms in chicks, see "White diarrhea of chicks."

Post-mortem appearance.—The ovary presents a characteristic appearance. The partially or wholly developed yolks are angular in outline, shrunken, hard, and discolored to a dark-brown or greenish color. (Fig. 6, *b.*) At times yolks containing dark fluid are present. The

pullorum disease is to detect the carrier hens and eliminate them from the breeding flock.

The disease may be detected in the carrier hen by means of an agglutination test of her blood. A small blood sample (about 1 or 2 teaspoons of blood) from each fowl is sent to the State laboratory or experiment station, where the test is conducted.

INFLAMMATION OF THE EGG DUCT (SALPINGITIS)

Inflammation of the egg duct has been found associated with various types of local inflammation of the egg-making organs, including that caused by *Salmonella pullorum*.

Symptoms.—Whitish diarrhea and a creamy discharge from the egg duct soil the feathers around the vent and cause redness and irritation of the skin. Other birds attack the affected individual, severely lacerating the posterior parts and in a short time disemboweling the victim.

The sporadic occurrence of bloody eggs, stinking eggs, misshapen eggs, yolkless eggs, eggs with blood-smearred shells, soft-shelled eggs, egg-bound, etc., may at times be traceable to isolated cases of salpingitis, and may be even the forerunner of a general outbreak of the disease.

Also many cases of peritonitis caused by the internal rupture of infected egg yolks may be variations of this disease.

Treatment.—When only a few birds are affected, relief may be afforded by douching the egg duct with a one-half of 1 per cent solution of creolin. Segregation of the visibly affected birds, thus protecting them from attack by others, should increase the number of recoveries. Male birds should be kept away, as they may spread the infection to healthy hens through breeding activity. This condition often occurs, however, even in virgin pullets, without reference to the activities of the male, and in this respect is different from vent gleet.

In outbreaks of salpingitis which may be traced to *S. pullorum* infection it would be unwise to use for breeding purposes any birds which had been affected, as to do so may cause the spread of pullorum disease in the chicks.

ASPERGILLOYSIS

Aspergillosis is a fungous disease of the lungs and air sacs which may affect any of the domestic birds. It is regarded as one of the causes of brooder pneumonia in baby chicks.

Cause.—The causative agent is the common green mold, *Aspergillus fumigatus*, which grows on vegetables and other kinds of matter. Warmth and moisture favor its development. When moldy hay, straw, or chaff is given to the fowls to scratch in, or moldy grain is fed, the spores of the fungus are inhaled by the birds.

Symptoms.—This disease may be limited to a single bird or it may assume the form of an extensive outbreak of brooder pneumonia. When the air tubes or lungs are attacked, the first symptom is a slight catarrh, with accelerated breathing. Soon the swellings obstruct the passage of air and there is a rattling or croupy sound, heard chiefly during expiration. The affected birds mope, separate

themselves from the remainder of the flock, or remain in a sitting posture; if made to move it is seen that they are weak and scarcely able to walk, and if they try to run they soon fall from exhaustion. The difficulty of breathing increases rapidly; they gasp for breath and make movements of the head and neck as if choking; there are fever, diarrhea, drooping wings, great depression, a tendency to sleep, and finally suffocation and death.

When the disease is limited to the large air sacs the only symptoms are weakness and progressive loss of flesh. If the small air sacs of the bones are involved there may be lameness, with swollen and inflamed joints. The symptoms in brooder chicks are similar to those of white diarrhea. The disease is always fatal. Young chicks die within a few days. Older birds may live from one to four or more weeks after the appearance of symptoms.

Post-mortem appearance.—The walls of the windpipe, air passages in the lungs, and air sacs in the abdominal cavity show whitish or yellowish nodules in the early stages of the disease. Later the walls are covered by elevated, dirty-yellow, or greenish layers, which represent growths of the mold.

Prevention.—The disease is prevented by giving only clean and bright straw or chaff for the fowls and brooder chicks to scratch in, by keeping the houses and yards clean, and using for feed grain and meal which are sound and entirely free from mold. The sick birds should be removed from the flock, and the bodies of those which die should be burned or buried.

CHOLERA

Cholera is a highly infectious, rapidly fatal disease of all domesticated birds. Birds of any age are susceptible.

Cause.—It is caused by *Pasteurella cholerae gallinarum* (or *P. avicida*), a germ which multiplies to enormous numbers in the blood and various organs of the body, producing a septicemia or blood poisoning. The disease is carried by sick or recently recovered birds which have been placed in a healthy flock, by wild birds, or by persons, animals, or poultry utensils which have been on infected premises. It spreads rapidly throughout the flock, owing to the fact that the first birds to become infected give off great numbers of the germs in their droppings and these germs are picked up by the other birds in feeding and drinking.

Symptoms.—The first symptom is a yellowish coloration of the droppings. This is followed by yellowish, brownish, or greenish diarrhea. The bird becomes droopy, feverish, and sleepy and sits with the head drawn down to the body or turned backward and resting in the feathers about the wing. Appetite diminishes and thirst increases. Breathing becomes difficult and may be heard at some distance. Finally the weakness is such that the bird can not stand but lies with the beak resting on the ground. It sleeps so soundly for some time before death that it can hardly be aroused. The comb and wattles may be a dark-bluish red, and the skin of the breast and abdomen is frequently reddened.

In very acute cases no symptoms are seen; the birds may be found dead under the roosts or they may fall while feeding or moving about

and die in a short time. During an acute outbreak sickness is seldom noticed more than 24 hours before death, which usually occurs within 3 days from the time of infection.

Cholera may destroy the greater part of a flock in a week and then disappear, or it may linger in a chronic form for months, only occasionally killing a bird. The chronic form is characterized by a continually increasing weakness, loss of weight, paleness of head, and finally an exhausting diarrhea. Sometimes one or more joints of the wings or legs swell, the bird becomes lame, and later the swellings break and discharge a creamy or cheesy mass.

Post-mortem appearance.—The heart has red spots or hemorrhages on its surface. The first portion of the intestines is congested and hemorrhagic, and the contents consist of a pasty mass, which may be bloodstained. The vessels of the visceral organs are congested. The liver may be enlarged and darker in color and the spleen may be swollen. A sticky fluid is frequently present in the mouth and nostrils.

Treatment.—Since treatment of affected birds is futile, the aim should be to prevent so far as possible the spread of infection. The first fowls showing acute feverish symptoms should be destroyed by a method which would guard against the contamination of the premises by infected blood. The carcasses should be burned or buried deeply. The healthy fowls should be moved to new quarters, if possible, and carefully watched for signs of disease. Houses and runs should be thoroughly cleaned at frequent intervals and disinfected with compound solution of cresol in 3 per cent solution or a reliable coal-tar disinfectant in proper dilution. The drinking water may be made antiseptic by adding one-third teaspoonful of permanganate of potash to each gallon, a procedure which tends to check the spread of disease by means of the water.

Too much dependence, however, should not be placed on the permanent effectiveness of antiseptics in drinking water. If the food or water supply of the fowls becomes contaminated, it should be removed and a fresh clean supply substituted.

CHOLERALIKE DISEASES

There are several diseases similar to cholera which have been investigated and described as different, because the bacteria which cause them differ in some of their characteristics. The symptoms and the changes which are seen after death are so nearly identical that it is only by studying the bacteria that any one of these diseases can be distinguished from the others. For the practical purpose of combating them in the poultry yard these diseases may be grouped together.

Cause.—Certain germs (bacteria), like *Escherichia coli*, which are nearly always found in the intestines of healthy birds, have more or less power to produce disease, but the sound, healthy bird is able to resist them under favorable conditions. When the resisting powers of fowls are diminished by exposure to cold, hunger, thirst, and exhaustion, as occurs during long shipments by rail, these germs may cause diseases. In some countries the sickness which develops from these conditions is called "the transportation disease."

It happens sometimes that these diseases develop in insanitary poultry yards, possibly because of the large numbers of germs taken into the bodies of the birds. When the germs begin growing in the tissues of fowls they soon increase their virulence, and the disease which they cause may rapidly spread from fowl to fowl until most of the birds are dead.

The choleralike diseases, therefore, may either develop in the poultry yard from insanitary conditions, or be introduced by contagion carried by new birds which are added to the flock, by birds which have been in exhibitions, by wild birds which fly from one poultry yard to another, or by various animals, such as dogs, cats, and rats. Birds which recover from the disease sometimes carry the germs and disseminate the contagion for six months or a year after they are apparently well.

Symptoms.—The manifestations of these diseases are much like those of cholera and for practical purposes need not be described separately. The choleralike diseases are differentiated from true cholera by their slower spread and lower mortality.

Treatment.—Treatment and prevention follow the same lines advised for cholera.

FOWL TYPHOID

Fowl typhoid is an infectious disease of mature chickens which has rarely been observed in other domestic birds. It attacks the blood and internal organs.

Cause.—The disease is caused by *Eberthella sanguinaria*, a micro-organism which is introduced on the premises through the agency of carriers, such as infected fowls, material from infected poultry yards, or by free-flying birds, or on the feet of persons or animals which have been on infected premises. Typhoid spreads through a flock in a manner similar to cholera and most of the other infectious diseases, but is not so destructive as acute cholera.

Symptoms.—These are drowsiness, fever, loss of appetite, and general weakness. The droppings are soft and yellowish or greenish. The membranes of the head, comb, and wattles are usually paler than normal, but in acute cases may be darkened with venous congestion. Complete prostration may develop in from several hours to one or two days before death. Symptoms become noticeable in from 4 to 6 days after infection takes place and last in fatal cases from 4 to 12 days.

Post-mortem appearance.—The internal parts of the body other than the liver and the spleen have a pale appearance. The mucous membrane or interior wall of the intestine is usually pale. The blood is thin, pale red in color, and does not clot readily. The liver is greatly enlarged and generally dotted with grayish spots. It has a tendency to break easily. The spleen is often swollen, pulpy, and filled with grayish spots. The kidneys are somewhat enlarged and lighter in color or slightly injected with blood. The heart appears normal or else pale, with grayish spots on its surface.

Treatment.—The treatment advised for cholera applies also to fowl typhoid, since sanitary measures must be depended on for its control.

TUBERCULOSIS

Tuberculosis is a chronic, infectious disease of domestic and wild birds. It is most common, however, in the fowl and pigeon. It is readily contracted by pigs, rats, and mice, but man is rarely affected by avian tuberculosis. Parrots and canaries are quite susceptible to human tuberculosis, while fowls are practically insusceptible.

Cause.—The disease is caused by *Mycobacterium tuberculosis avium*. Tuberculosis is generally brought into the poultry yard with fowls that are purchased from infected flocks. If the disease exists in neighboring flocks the contagion may be carried by small birds or animals passing from one yard to another. A peculiarity of tuberculosis of birds is that the liver and intestines are nearly always very severely affected, and that as a consequence the organisms are very numerous in the intestinal contents and are scattered with the droppings everywhere that the fowls go. The introduction of a single diseased bird, therefore, may cause the infection of the greater part of the flock in a few weeks. In the same way, when wild birds contract the disease, the germs are carried and deposited in all the yards which they visit.

Pigs, rats, and mice are especially liable to be infected with fowl tuberculosis by eating the carcasses of birds which have died, and these animals serve to keep up the contagion and may communicate it to other fowls especially if the latter eat the carcasses of rats or mice that died of the disease.

Symptoms.—Although birds may become infected at any age, the disease usually progresses slowly and symptoms are generally not observed until the affection has reached an advanced stage. Hence it is the older fowls, those more than 1 year of age, which display the most pronounced symptoms and show a high death rate.

Signs of disease begin with gradual loss of weight, wasting of the muscles, especially noticeable in the breast, paleness of the comb, and, toward the end, dullness, sleepiness, and diarrhea with yellowish or greenish droppings. Very often there is at the same time a tuberculous inflammation of the joints and of the sheaths of tendons, which is revealed by lameness and swelling of the joints and legs. Occasionally the skin over the swollen joint breaks, the interior of the joint is ulcerated, and a small quantity of cheesy material is discharged. Deaths in the flock occur at intervals. Affected birds may live only a short time after symptoms are noticed, or they may live for weeks.

Post-mortem appearance.—On post-mortem examination grayish-white or yellowish-colored tumors of varying sizes are observed in the internal organs, but especially in the liver, spleen, and intestines. These tubercles when cut open present a solid, grayish, glistening interior which in the larger ones exhibits yellowish centers or a number of yellowish points. Those of more advanced growth show extensive, yellowish, cheesy, or crumbly masses in their interior. (Fig. 7.)

Treatment.—There is no treatment that will cure tuberculous birds. The most thorough method of eradication is to slaughter the entire flock when indications point to an extensive outbreak. Fowls in good flesh, showing no lesions or slight ones may be used for food.

Those badly diseased and all visceral organs of the others should be destroyed.

The chicken houses, inclosed runs, and all eating, drinking, and other utensils should be thoroughly cleaned and disinfected with a strong disinfectant solution. After disinfection the premises should be kept free of fowls for a year, if possible, or new stock may be placed on ground which has not been occupied by poultry for a year or more. In restocking, obtain birds or eggs for hatching from flocks which have shown no signs of an infectious disease for a year or more.

When the breeding value of the fowls or other interests make it undesirable to dispose of the entire flock tuberculosis may be controlled to a great extent by disposing of all birds at the end of the second laying period. Younger birds should be disposed of whenever they appear to be abnormal.

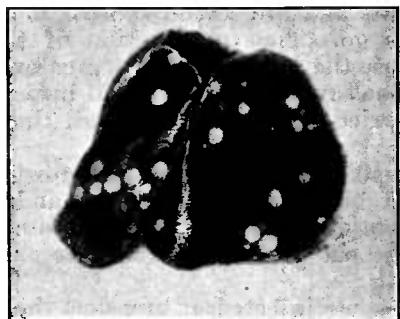


FIGURE 7.—Liver of pheasant, showing lesions of tuberculosis

the Office of Information, United States Department of Agriculture, Washington, D. C.

LEUKEMIA

Leukemia is an infectious disease which affects principally chickens and runs a chronic course, manifested by drowsiness, droopiness, and emaciation. There is a marked pathological change in the character of the blood, the red cells becoming less numerous and the white cells rapidly multiplying to greatly disproportionate numbers. Sick birds die, as a rule.

Autopsy of fowls dead from leukemia may reveal an enormous enlargement of the liver, sometimes of the spleen and kidneys. These organs may be rendered uniformly pale by the general infiltration of white blood cells into their structure, or, as is sometimes the case with the heart, they may be spotted with circumscribed or coalescing areas of leukemic deposits.

No reliable treatment for leukemia is known, although potassium iodide, from 3 to 7 grains daily, with tonics, has been recommended. Sick birds should be isolated and the premises periodically disinfected. Sporadic cases had better be slaughtered and disposed of, and carcasses of birds dying of the disease should be burned or buried.

Feed and water receptacles should be kept clean and sanitary at all times, and antiseptics added to the drinking water.

The eradication of tuberculosis from a poultry flock may be greatly assisted by the application of a tuberculin test to each bird and the elimination of the reactors, followed by rigorous sanitary measures. The test should be applied and interpreted by a qualified veterinarian.

More detailed information on tuberculosis of fowls is given in Farmers' Bulletin 1200, a copy of which may be had on request to

EDEMA OF THE WATTLES

Edema of the wattles is a local swelling caused by their filling up with a dropsical fluid. The condition is caused by a germ analogous to that of fowl cholera. While the death rate from this infection is not high, the birds thus affected (principally males) are weakened and thus rendered comparatively defenseless from the attacks of more vigorous birds.

Keeping an antiseptic, such as potassium permanganate or iron sulphate, in the drinking water is of some value in checking the spread of the disease by that means. The cropping (or surgical amputation) of the wattles has been found to be more practical, however. The wattle is grasped firmly with a strong-jawed clamp and severed with clean scissors. Before removing the clamp, the cut edges of the stump should be painted with tincture of chloride of iron to prevent hemorrhage. A dusting powder of equal parts of calomel and powdered burnt alum may be applied later to prevent subsequent hemorrhage or infection.

The bird should be isolated, if possible, until healed.

EUROPEAN FOWL PEST

European fowl pest is a very acute, infectious disease, affecting particularly chickens, turkeys, and geese. Blackbirds, sparrows, owls, hawks, and other birds also contract the disease, while wild waterfowl and pigeons are resistant. Mammals, including the human, are not susceptible. The malady was first discovered in Italy in 1878, since which time it has spread north, west, and east, and is now prevalent in Germany, France, Belgium, Austria, and Hungary. Its first appearance in the United States was in the vicinity of New York in the latter part of 1924 and it was eradicated in 1925.

Cause.—The infective agent is present in the blood and various tissues of the bird. It is so very small that it passes through the finest pores of a filter, and no microscope is powerful enough to detect it.

Symptoms.—The disease is characterized by its extremely infectious nature, rapidly progressing course, and high mortality. The infected fowl loses its appetite, has an irregular walk, and becomes very droopy. The feathers are ruffled, and there is considerable prostration, with swelling and darkening of the comb and wattles. A sticky exudate may paste the eyelids together, clog the nasal passages, and even obstruct the windpipe, causing labored breathing. Some patients periodically shake their heads in order to dislodge this mucous secretion from the throat and nostrils, at the same time producing a peculiar, wheezy sound. The bird lives as a rule for from 2 to 5 days, occasionally 6 or 7. In the very acute form of the disease the bird may be apparently in good condition in the morning and be found dead in the afternoon.

Post-mortem appearance.—On post-mortem examination no lesions at all may be found, on account of the suddenness of the death. In the less acute cases—that is, in those that live for three or four days—there is a mucous exudate in the nostrils, larynx, and windpipe, with bloodstained patches and sometimes blood clots in the

windpipe. The lungs are usually more or less pneumonic. A hemorrhagic or bloodshot condition is found on the crop and under the skin in various other parts, sometimes accompanied with a gelatinous substance. Hemorrhagic spots on the muscle and sac of the heart, on the gizzard fat, on the outer surface of the small intestines, and especially on the inner lining of the two stomachs, the glandular stomach and the muscular stomach or gizzard, are typical of fowl pest. These little hemorrhagic patches may be found along the entire intestinal canal, with considerable catarrhal condition, and when that is marked the bird has a profuse diarrhea, but the latter is not always present. A serous fluid is sometimes seen in the heart sac, or in other cases in the body cavity.

Control measures.—There is no remedy from a medical standpoint, and since treatment has thus far been futile, the aim should be to prevent, so far as possible, the spread of infection. Sick fowls should be killed promptly, without contaminating the premises, and the carcasses burned or buried deep. The healthy fowls should be moved to new quarters and carefully watched for signs of disease. Houses and runs should be thoroughly cleaned frequently and disinfected with a 3 per cent solution of cresol compound. The drinking water may be made antiseptic by adding one-third teaspoonful of permanganate of potash to each gallon, a procedure which tends to prevent the spread of disease. All infected coops, shipping and receiving centers, fattening plants, and poultry cars should be thoroughly cleaned and disinfected.

In Italy and Germany experiments have been conducted with a serum for both protective and curative purposes.

Following the first appearance of the disease in the United States in 1924, embargoes were declared against a number of poultry-producing States of the Middle West by New York City and by the States of New York, New Jersey, Maryland, Pennsylvania, Connecticut, and other Eastern States. These embargoes were declared primarily as a protection to the poultry flocks of the States concerned and not through the necessity of protecting the public health. In fact, no ground exists for any public fear of endangering human health from this disease. Measures taken by the health authorities at the various markets are adequate to assure the public that all poultry offered for sale is healthy and safe to eat.

The Department of Agriculture forbade the interstate movement of diseased and exposed birds, as well as carcasses of birds which had died of the disease. The interstate movement of manure and litter from diseased fowls also was prohibited. Cleaning and disinfecting coops, troughs, cars, premises, and accessories that might have been contaminated were required under supervision.

A minor outbreak of the disease occurred in an isolated section of New Jersey in the summer of 1929, but was soon eradicated by concerted State and Federal action. Although European fowl pest is not known to exist in the United States at this time, farmers and poultry producers in all parts of the country are requested to report at once to the State authorities concerning any unusual symptoms among their poultry and to isolate any suspected birds.

GOUT

Gout is marked by the presence of an abnormal quantity of uric acid in the blood, which results in the deposit of urates on the internal organs (visceral gout) or more frequently in the joints (articular gout).

Cause.—The increased quantity of uric acid may be induced by several causes. Prolonged feeding on substances rich in albumin, especially if associated with lack of exercise, is probably the most frequent predisposing factor. Diseases which affect the urinary organs, causing a failure to eliminate the uric acid properly, play an important part in the causation of gout.

Symptoms.—The joints of the feet are most frequently and severely affected, although the wing joints may also be involved. At first the joints are swollen and painful.

Later the lesions form into nodular, tumorlike growths which vary in size and may be either hard or fluctuating. (Fig. 8.) Frequently the swellings burst, discharging a yellowish, turbid material containing urates. The bird avoids walking as much as possible and remains in a sitting position. The general health becomes affected and emaciation gradually occurs, with weakness and frequently diarrhea. Visceral gout is apparent on autopsy only. The internal organs and serous membranes are found covered with chalklike deposits. The course of the disease is slow.

Treatment.—Artificial Karlsbad salt has been beneficial. This is prepared by mixing together sodium sulphate 22 grams, potassium sulphate 1 gram, sodium chloride 9 grams, and sodium bicarbonate 18 grams. Six grams (or one-fifth of an ounce) of this mixture are added to 1 quart of drinking water. Tincture of colchicum in from 2 to 5 drop doses per bird may also be used. Enlarged joints may be opened and the contents washed out. When moderately severe symptoms are shown it is best to fatten and kill the bird before the onset of emaciation. When several fowls in the flock develop symptoms the diet should be looked into and corrected. Often a reduction in the quantity of meat scrap and an increase in green feed will prevent additional cases. The entire flock should receive a dose of Epsom salt, one-third teaspoonful to each adult bird.

OBESITY

Obesity is an abnormal state of fatness and plethora induced by prolonged heavy feeding of starchy feeds, with insufficient exercise.



FIGURE 8.—Chicken affected with articular gout. (After Kionka)

It sometimes offers mechanical interference to egg laying and tends to cause internal rupturing of egg yolks, leading to death. Obesity may retard other body functions, such as circulation of blood, digestion, and assimilation of feed. The heavier breeds are more susceptible.

Treatment.—Feed finely cut grain in moderate allowances, scattering it in deep litter, thus encouraging exercise. Reduce starchy ingredients of mash, and supply sprouted oats or other greens.

RACHITIS (RICKETS)

Rachitis (rickets) is a disease of the bones of growing animals or fowls caused by insufficiency of lime salts in the feed. The bones are soft and deformed, as is frequently shown in chickens with crooked legs or crooked breasts. Catarrh of the intestines sometimes occurs.

To aid in overcoming a tendency to rickets in baby chicks give fresh cod-liver oil daily in the mash, allowing 1 ounce for 50 chicks, or one-half pint for 400 chicks. Direct sunlight (not through window glass) is also highly efficacious in preventing rickets. A so-called flexible glass, which is said to permit the passage of the anti-rachitic sun rays, may now be obtained on the market. This product is replacing glass on many poultry farms.

Growing birds should receive a varied ration, including green feeds, and a supply of ground oyster shell or bone.

POLYNEURITIS

Polyneuritis is a nutritional disease affecting birds of any age, although young birds are most susceptible.

The condition is due to the deficiency of water-soluble vitamin B in the ration. This food substance is present in many green feeds and whole grains. A restricted ration of degerminated grain is not suitable for poultry.

The symptoms of polyneuritis are loss of appetite, emaciation, leg weakness, and spasmodic movements of the head or limbs.

Treatment.—Treatment simply consists in the feeding of entire mixed grains and green feeds, together with a mash in which meat or fish scraps is included. Sprouted oats are fine for both growing chicks and laying hens.

TUMORS

Tumors are of frequent occurrence in birds and present a number of varieties. The largest percentage is found in fowls more than two years old. In hens the egg organs are affected in more than 50 per cent of cases. Bird tumors have a marked tendency to break down and cause death from internal hemorrhage. Tumors on the skin are easily recognized, while internal ones may be suspected when an individual in the flock shows poor condition, increasing droopiness, or emaciation.

Treatment.—There is no treatment for internal tumors. External ones can be removed satisfactorily in some cases by an operation. Since many of the growths, however, are of a malignant or cancerous nature, it is best to kill the bird and destroy the carcass.

ROSE-CHAFER POISONING

Rose chafers are extremely poisonous to chickens under 10 weeks old. When these beetles are on vegetation chickens devour them readily, and only a few are necessary to cause death.

Symptoms.—Signs of poisoning may appear as early as one hour after feeding on the chafers, and death may follow in one hour after the appearance of symptoms. If sufficient poison is not absorbed to cause death, the bird recovers. The affected chicken becomes drowsy, shows weakness of the legs, and falls over on its side. There may be convulsions. Sharp cries are frequently emitted, and the head and neck are retracted over the back of the bird. The only internal sign is the presence of rose chafers in the crop.

Treatment.—The rapid action of the poison renders treatment futile in birds showing symptoms. When the nature of the trouble is realized, others of the flock which had opportunity to eat chafers should be given Epsom salt in the proportion of one-fourth teaspoonful, mixed with a small quantity of feed, to each bird. Preventive measures consist in keeping young chickens in inclosed runs or at points where they will not have access to grapevines, rosebushes, and shrubbery when the insects are prevalent. This corresponds somewhat closely to the time of first blossoming of the various garden flowers. Destruction of the beetles should be practiced by spraying infested plants with one-half or three-fifths of a pound of lead arsenate to 10 gallons of water.

LEG WEAKNESS (PARALYSIS)

Leg weakness is a term commonly used to describe a condition of birds in which there is unsteadiness of gait or inability to stand. It is not a specific disease, but is a symptom associated with a number of diseases.

Cause.—Among the causes may be mentioned the various infectious diseases which produce extreme debility, such as cholera and the choleralike diseases, fowl typhoid, coccidiosis, enterohepatitis or blackhead of turkeys, tape-worm infestation, and white diarrhea of chicks. Other causes are mineral and food poisons, including those of vegetable and animal origin, rickets from lack of lime salts in the feed, polyneuritis from lack of vitamins in the feed, close confinement of growing chicks, and paralysis.

Treatment.—An effort should be made to determine whether an infectious disease or a poison is the cause and to treat accordingly. If deficiency in necessary mineral or other elements in the feed is the probable cause, a wide variety of feed with plenty of green feed should be given and the birds allowed ample room for exercise, or they should be turned out on free range. Ground oyster shells or calcium phosphate should be fed freely, and 1 dram of copperas may be added to each gallon of drinking water. Leg weakness in young chicks, when due to confinement with lack of sunlight, soil, and space for exercise, is corrected by giving cod-liver oil, 2 or 3 drops per bird, mixed in the feed daily.

LAMENESS IN GEESE AND DUCKS

Geese and ducks are affected with an inflammatory condition of the joints of the feet and wings associated with an internal infectious disease.

Cause.—The disease is caused by a microorganism known as *Staphylococcus aureus*, which multiplies in the internal organs and in the bones and joints.

Symptoms.—Principally young ducks and geese are affected. The disease may be acute, causing death in from two to four days, or chronic, with symptoms continuing for more than two weeks, when death may occur or gradual recovery take place. In acute cases there is general depression, diarrhea, and discharge from the eyes. In chronic cases the general symptoms are less marked but emaciation is pronounced. The characteristic symptoms in both cases are lameness and swelling of the joints of the legs or feet. Usually only one leg may show lameness, and the hock joint or one of the toe joints is most often affected. The swellings are hot and painful. The bird frequently lies on its breast with legs extended backward and, if forced, can move only short distances by flapping the wings. Sometimes the wing joints are swollen and the wings droop.

Post-mortem appearance.—The intestine is inflamed and its contents are slimy and reddish in color. The liver and spleen are enlarged. The diseased joints are reddened, swollen with fluid, and contain yellowish, fibrous, or cheesy exudates.

Treatment.—Acute cases do not respond favorably to treatment. The joints should be painted daily with tincture of iodine. Separate the sick from the well and keep the houses and utensils clean and disinfected. Keep the ducks and geese from stagnant water, and when giving drinking water dissolve one-third teaspoonful of permanganate of potash in each gallon.

WING LAMENESS IN PIGEONS

Pigeons have swollen and disabled wing joints as a result of tuberculosis, gout, or mechanical injuries. They also are affected with a disease, seen on the head, neck, or wings, which is caused by an infectious organism resembling somewhat the causative agent of tuberculosis. This germ grows underneath the skin and induces the formation of lumps of yellowish, cheesy material which enlarge to the size of a marble. When these lumps are present in the wing, especially near a joint, flight may be impaired or made impossible.

Treatment.—Lance the skin over the growth, press out the ball of cheesy matter, and paint the cavity with tincture of iodine daily for several days.

BUMBLEFOOT

Bumblefoot is a term applied to a swelling of the foot and is most often seen in fowls. It may result from bruises, as in the case of heavy birds jumping from high perches to hard surfaces, or it may be due to cuts or punctures of the skin of the foot which becomes infected by germs. These organisms set up an inflammation and the formation of fluid or cheesy, suppurative material, usually in the ball of the foot.

Treatment.—In some cases the application of tincture of iodine to the swollen area daily for several days will bring about recovery. If the swelling is hot and has the appearance of an abscess, it should be lanced and the contents washed out. The interior of the abscess is then soaked with 5 per cent carbolic acid or tincture of iodine and the foot bandaged. The fowl should be placed in a small compartment without a perch and the wound disinfected daily for several days.

EGG-BOUND

The condition known as "egg-bound" (failure to pass the egg in the normal manner) is of frequent occurrence in fowls, especially in pullets when beginning to lay.

Cause.—The difficulty may be due to inflammation, stricture, or tumor formation in the posterior part of the egg passage. Sometimes malformed or double-yolked eggs are responsible. In pullets the usual cause is an attempt to lay large-sized eggs before the egg passage has become sufficiently dilated to accommodate them.

Symptoms.—Affected hens become restless and make frequent visits to the nest in efforts to lay. The straining may cause inflammation and often eversion of the oviduct (egg tube) through the vent. Others of the flock, attracted by the inflamed, protruding parts, peck at them and tear out portions of the egg passage and intestine, causing the death of the hen. If prolapse does not occur the distressed fowl may continue her effort to lay until successful or until overcome by weakness or internal hemorrhage from rupture of the oviduct. The egg may be felt by passing the forefinger through the vent.

Treatment.—The surest method of treatment is to remove the egg by the following procedure: Pass the forefinger through the vent. With the other hand pressing on the abdomen of the fowl force the egg toward the vent, guiding it by the aid of the inserted finger. When the shell is observed through the vent puncture it with an awl or other sharp-pointed instrument, break it in pieces, and withdraw these and the egg contents. Isolate the bird and inject cold water into the cloaca (the common passage into which the intestine and the oviduct open) to reduce the inflammation. If the oviduct has been everted through the vent, clean and push the parts back and inject cold water frequently until the tissues remain in place.

VENT GLEET

Vent gleet is an infectious, venereal disease of fowls which is spread by the rooster in treading. Its causative agent is not known.

Symptoms.—There is inflammation of the cloaca and vent. The skin around the vent is swollen, reddened, and ulcerated, and an offensive odor is usually present. The droppings are foul smelling and liquid and are frequently voided. Other chickens may peck at the inflamed part and often tear the cloaca and rectum, causing death of the victim.

Treatment.—The disease is very resistant to treatment. It is usually better to destroy the bird. If treatment is desired, 5 per cent carbolic acid or 2 per cent carbolic ointment may be applied daily over the affected area. Argyrol in 20-per cent solution may be in-

jected into the cloaca twice daily. Remove the roosters from the flock while the disease is present, and destroy any found affected.

FEATHER PULLING

Feather pulling is a vice which may originate from several causes, such as close confinement, with idleness, lack of sufficient mineral or animal matter in the feed, or the presence of itch mites at the base of the feathers (see "Depluming scabies"). A particularly vicious hen may begin the practice, which may be imitated by others of the flock and continued as a habit.

Treatment.—Allow as much room as possible for exercise. Scratching for feed in deep litter helps to keep the birds busy. Provide a variety of feeds with meat scrap and plenty of green feed and crushed oyster shell. The early discovery and isolation of the principal offenders will frequently check the trouble where it is merely a habit and not due to other causes. If mites are present, treat as for depluming scabies.

Feather pulling and cannibalism may be prevented by cutting off the tip of the upper beak about three-sixteenths of an inch from the point.

TOE PECKING

Toe pecking is observed in young chicks, especially those confined in brooders. Chicks peck at feed stuck to the foot and wound the skin. The taste of blood causes them to continue pecking at the toes of the victim and to attack other chicks. They may also peck at the vent and disembowel the chick in a short time.

Treatment.—Remove all wounded birds as soon as they are observed and isolate them until recovery is complete. Keep the chicks occupied by hanging vegetables or bones with shreds of meat attached at a height which will cause the chicks to jump in reaching them.

IMPACTED CROP (CROP-BOUND)

The affection known as "crop-bound" or impacted crop is an over-distended and paralyzed condition of the crop, generally caused by overeating or by swallowing coarse and indigestible substances, such as feathers or fibrous feeds. In cholera the crop is paralyzed as a result of the disease.

Symptoms.—The first symptom is a loss of appetite, or an effort of the bird to swallow without being able to do so. The crop is seen to be very large and much distended, with contents more or less firmly packed together. If permitted to continue, the condition becomes aggravated, the breathing difficult, and death may result.

Treatment.—The contents of the crop may be removed sometimes by forcing the bird to swallow a teaspoonful or more of sweet oil and massaging the lower part of the gullet, if it contains feed or, if not, part of the crop nearest to the gullet, until the contents are softened and may be pressed toward the head. This is made easier by holding the bird head downward. By continued manipulation the greater part of the material may be removed. The bird should not be permitted to eat for several hours after it is relieved. If this plan of treatment is not successful, the crop must be opened with a sharp

knife and the contents removed through the opening, using for this purpose a coffee spoon, a buttonhook, small forceps, a bent wire, or other suitable instrument. Then wash out the crop with clean, warm water. The opening should not be more than an inch in length and should be closed with three or four stitches, first in the wall of the crop and, when this is finished, an equal number in the skin. Each stitch should be made and tied separately. Coarse, white silk is the best material, but if it is not at hand ordinary cotton thread may be used. Feed for a day or two on milk and raw egg, beaten together, and gradually change to soft mash.

INDIGESTION

The term "indigestion" includes numerous conditions which may be attributed to digestive disturbance, such as loss of appetite, pica (abnormal or depraved appetite), sour or hanging crop, impaction of the gizzard, diarrhea, or constipation.

Causes.—The principal causes are irregularities of feeding, such as feed that is too coarse, dry or fibrous, moldy or decayed feed, access to poisonous plants or irritating chemicals, lack of grit in the gizzard, or polluted water supply.

Indigestion may also occur as a symptom of some specific diseases, such as catarrh of the crop or stomach, enteritis, coccidiosis, or worms, in which cases special treatments would be indicated.

Treatment.—In the treatment of simple indigestion, the ration should be clean, wholesome, nutritious, and easily digestible. The process of digestion may be aided by a constant supply of grit, charcoal, and crushed oyster shell. If indigestion is from impaction of the gizzard or from constipation, Epsom salt, 1 pound to each 10 quarts of drinking water, may be placed before the flock for one day instead of other drinking water; or castor oil, 1 pint per hundred birds, may be fed thoroughly mixed in a moist mash.

Sour or hanging crop may be treated by flushing out the crop, using a fountain syringe, with a bicarbonate of soda solution, consisting of 2 teaspoonfuls of the soda to a pint of warm water. Empty the crop by gentle pressure, with head of bird down. Repeat daily until recovered. Keep the bird on a soft diet, principally sour milk or buttermilk, for several days after recovery takes place.

Following attacks of indigestion it is sometimes beneficial to stimulate the appetite and promote the secretion of digestive fluids by the administration of a mild tonic. For this purpose 2 or 3 tablespoonfuls of the following mixture may be added to each 10 quarts of the dry mash: Powdered gentian, 1 pound; powdered ginger, one-fourth pound; bicarbonate of soda, one-fourth pound; powdered iron sulphate, one-half pound; cayenne pepper, 2 ounces.

This tonic should also be given for depraved appetite.

LIMBER NECK

The condition known as limber neck is a symptom of several diseases, among which are botulism or other food poisoning, which are characterized by a paralysis of the muscles of the neck, which makes it impossible for the bird to raise its head from the ground. This condition is due to the absorption from the crop or intestines of

poisons which act on the nervous system and cause paralysis. It is generally associated with the eating of spoiled feed or putrid meat in which certain poison-producing organisms are growing, or of fly maggots which have bred on such material.

Treatment.—The best treatment is to give a full dose of purgative medicine—that is, one-half teaspoonful of Epsom salt, or 3 or 4 teaspoonfuls of castor oil for a grown fowl. Unless treatment can be given very soon there is little hope of saving the bird. Spoiled canned goods should not be fed to chickens. Carcasses of fowls or other animals should be burned or buried deep as soon as found.

FAVUS (WHITE COMB)

White comb, baldness, or favus of fowls is a contagious disease that begins with the formation of grayish-white spots on the comb, ear lobes, or wattles. (Fig. 9.)

Cause.—This disease is caused by a fungus called *Lophophyton galinae* and is transmitted from fowl to fowl by simple contact.



FIGURE 9.—Favus (white comb). (After Sabouaud)

white crusts with an irregular surface. As the disease advances the neck and body are gradually invaded and the feathers become brittle and break off, leaving a deep depression in the center of a cup-shaped disk. Occasionally the disease is inoculated into the feathered parts of the skin and begins there instead of on the bare parts of the head, but this is exceptional. The disease when limited to the comb and wattles may disappear without treatment, but after it has invaded the feathered parts it almost invariably continues to advance, and the birds grow weaker until they die from the disease or some other to which their debilitated condition has made them abnormally susceptible.

Treatment.—When only the bare parts of the head are affected, the disease may be cured by applying tincture of iodine to the diseased spots. An ointment of calomel 1 part, vaseline 8 parts, or a mixture of soft soap 20 parts, carbolic acid 1 part, may be applied daily. An ointment of red oxide of mercury 1 part, vaseline 8 parts, is also used, as well as olive oil containing 2 per cent carbolic acid. It is essential to separate the affected bird from the flock. If the feathered

parts of the body are affected, it is better to kill the bird, as the treatment is long and expensive and there is danger of spreading the disease. The disease should be prevented by excluding all affected birds, by burning the bodies of those that die or are killed, and by disinfecting the houses where diseased birds have been.

PARASITES AND PARASITIC DISEASES

A number of different kinds of parasites found in poultry in the United States may seriously affect the health of the birds. These parasites may be divided into three general groups. One group, known as Protozoa, consists of organisms so small that they can be seen only with the aid of a microscope. The second group consists of worm parasites, of several kinds, all but a few of which are sufficiently large, when full grown, to be seen with the naked eye. The third group is made up of small, parasitic arthropods, namely, certain insects (including lice and fleas), and certain mites, which include not only mites as commonly known but also ticks. The location of parasites varies greatly with the different kinds of parasites; Protozoa may occur in the blood stream, in the kidneys, and in the intestines of certain domestic birds; worm parasites may occur in such varied locations as the eye, the windpipe, all parts of the digestive tract, the reproductive organs, and in or under the skin; and arthropod parasites of poultry occur chiefly on the outside of the body, either on the feathers or in or under the skin, but, on the other hand, in the case of certain mites, may occur within the body, in the air passages, lungs, and liver.

METHOD OF EXAMINING FOWLS FOR PARASITES

An examination of a domestic bird, for the purpose of determining whether parasites are present, must take into consideration these differences in the kinds of parasites and their possible locations. As regards the internal parasites, for locating Protozoa, smears or sections made from infected parts of the bird, must be examined microscopically. On the other hand, to locate worm parasites and the mites which occur within the body, the various parts of the body may be examined according to some such procedure as the following:

In examining a dead fowl the feathers are removed from the under side, the abdomen is carefully opened along the median line, and the breast is cut loose on each side and turned forward, as in Figure 10. The various internal organs are then carefully loosened from the tissues which hold them in place, and, after being spread out, as in Figure 11, so that they can be separated and identified, they are removed from the bird. The windpipe or trachea (*a*) is cut open and its inner surface examined; the lungs (*k*) are also removed and carefully inspected. The esophagus, including the undilated part and the crop (*b* and *c*), is slit open and the contents washed into a shallow glass dish and examined; the wall of the esophagus is examined by stretching it between the hands and holding it up between the observer's eyes and the light so that the light shines through it and thus throws into relief the outline of any worms embedded in the wall. The remainder of the digestive tract, made up of the two stomachs, namely, the glandular stomach (*h*)

and the muscular stomach or gizzard (*f*) and the intestines (*g*), is next cut loose and lifted out into a dish of water. The glandular stomach or proventriculus (*h*) is opened and washed into a glass dish and the glands are squeezed so that embedded parasites may be loosened; the wall is examined on both the inner and outer surfaces, one of the nematodes found in this location, namely, the

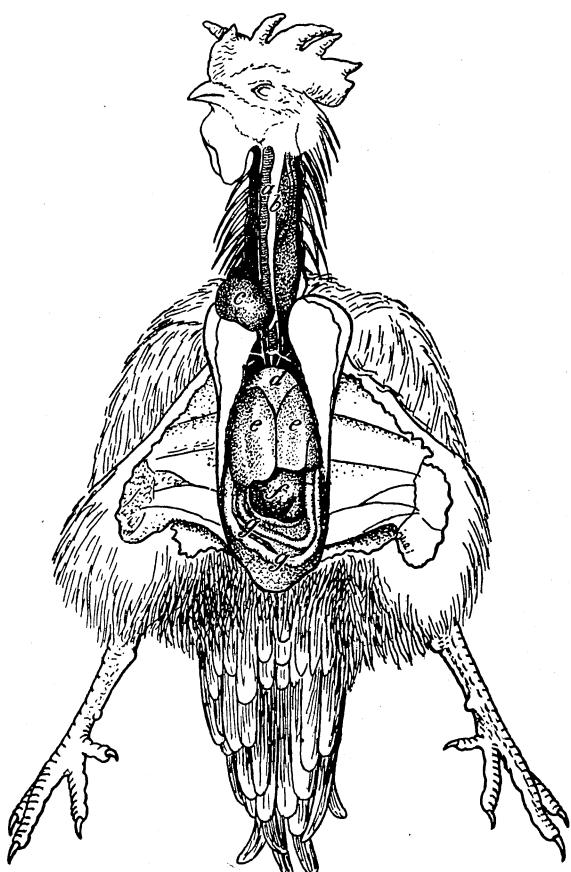
globular, red tetrermere, often showing more clearly through the semitransparent outer surface than through the opaque inner surface. The muscular stomach or gizzard (*f*) is opened and its contents are emptied out and examined; the horny lining is then peeled off and the under surface of the lining and also the newly exposed surface of the muscular wall are examined for parasites. The small intestine (*g*) and finally the ceca (*i*) are slit open in water, separately; the wall of these organs is run through between the thumb and fingers and examined carefully during the process, in order to remove any parasites which are buried in the mucus or attached to the wall; the intestinal contents may be washed and allowed to settle several times until the water is clear, and then examined in shallow glass dishes.

FIGURE 10.—Appearance of internal organs when fowl first is opened up. See Figure 11 for explanation of letters.
Adapted from Sunderville, 1928

eral times until the water is clear, and then examined in shallow glass dishes.

METHOD OF KILLING AND PRESERVING PARASITES

Protozoa can be found to best advantage in fresh material, and in the case of certain organisms belonging to this group they can be found only in such material. In other cases, as the coccidia, if microscopical examination can not be made on the intestinal contents when they are fresh, such material may be satisfactory for examination if



preserved by the addition of formaldehyde solution. Worm parasites which have been collected should be well washed in water in order to remove all mucus or other clinging material, and should then be put into a weak solution of formaldehyde (from 2 to 4 per cent), which has been warmed to the point at which it begins to steam. Material of this sort can be shipped to laboratories for identification.

Arthropod parasites may be preserved in 2 per cent formaldehyde solution or 75 per cent alcohol.

VARIOUS METHODS OF REPRODUCTION AND OF SPREAD OF PARASITES

The different kinds of parasites of poultry have very different life habits. A knowledge of these habits is important in understanding the diseases caused by them and in deciding on methods of checking those diseases. Protozoa, for instance, multiply within the bird's body so that one organism may give rise to large numbers of organisms. (Fig. 15, A.) Worm parasites, on the other hand, do not multiply within the bird's body; a single egg or single young parasite which gains entrance into the body develops into only one worm, and multiplication depends on the eggs or young worms produced by such a parasite; the parasite eggs or young worms must pass out of the body and undergo more or less development on the ground or in such lower animals as insects before giving rise to additional parasites in birds.

The development of the various stages outside the bird's body differs greatly in different worm parasites. In some cases there is a direct life history; the parasite eggs which pass out of the body develop within them the young stage of the worm which on being taken into the body of a bird will infect it and will develop to an

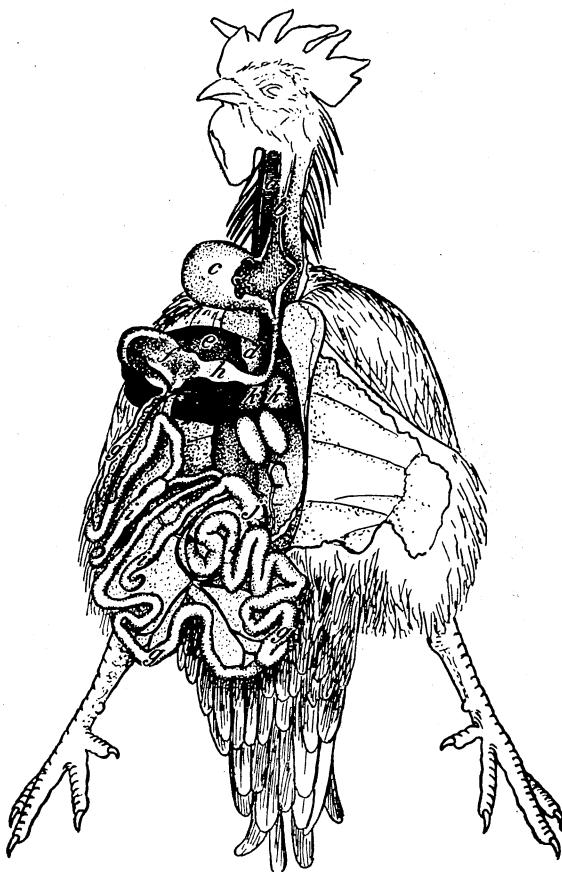


FIGURE 11.—Internal organs of fowl, which have been spread out: *a*, Windpipe or trachea; *b*, undilated esophagus; *c*, crop; *d*, heart; *e*, liver; *f*, gizzard; *g*, intestines; *h*, glandular stomach; *i*, ceca or blind guts; *j*, rectum; *k*, lungs. Adapted from Sunderville, 1928.

adult parasite. In other cases the life history is indirect; the bird is known as the primary host and the parasite eggs which pass out of its body must go into one or more intermediate hosts before again going back to a bird. An example of such an indirect life history is given subsequently with reference to one of the flukes found in birds. In the cases of indirect life histories of tapeworms and roundworms, only one intermediate host is necessary, so far as is known; the nature of the intermediate host may vary and is still unknown for some parasites, but in certain instances insects, snails, slugs, and earthworms have been found to serve in this capacity.

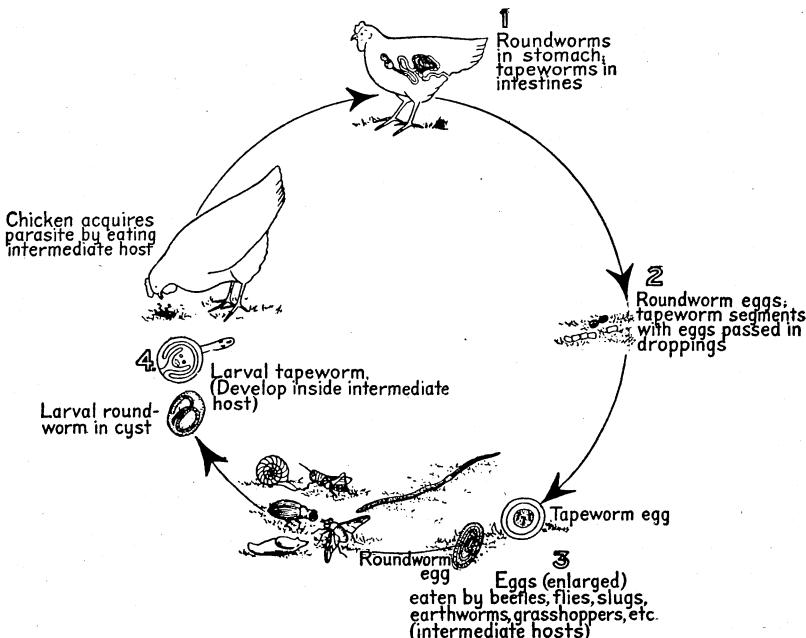


FIGURE 12.—Diagram of the various stages in an indirect life history of a tapeworm or roundworm, parasitic in poultry

Figure 12 gives in diagrammatic form the various steps in such a life history.

GENERAL MEASURES FOR THE CONTROL OF PARASITES OF POULTRY

In the arrangement of houses and yards they should be so placed that rain water will not wash from one to another. Marshy places should be drained and holes in which water may collect should be filled in. Even if permanent quarters must be used to some extent a rotation of yards is highly desirable; the ground should be ploughed under and then planted to green stuff when the yard is not in use.

The most severe damage from parasites occurs in young birds, so special precautions should be taken to protect the young. They should be raised away from the older birds, which are often carriers of parasites, and from the infected areas occupied by them.

As regards sanitation, feed and water should be given in containers which will not allow contamination of the contents with the birds' droppings. The frequent removal and disposal of droppings are likewise important preventive measures. Disposal should be by a method which will keep the droppings with their content of worm eggs and Protozoa not only from the chickens but also from the intermediate hosts of the parasites and from wild-animal life which may serve as carriers in one way or another. It is advisable to keep yards free from boards and miscellaneous objects, since they may harbor such intermediate hosts or carriers. Filling in or draining low, damp areas which may breed such intermediate hosts, and the screening of houses are also of value in this connection. A screen, to be effective, should have a mesh small enough to keep out even such small insects as the smaller dung beetles.

The practice of using chicken manure as fertilizer is dangerous from a poultry standpoint, if the manure is spread in places where chickens will have access to it or in places where small animal forms may feed on it and may serve as intermediate hosts or as mechanical carriers to convey parasites back to the poultry. The danger is lessened if the chicken manure is stored in a manner that causes it to heat. The development of heat in the chicken droppings during storage tends to destroy worm eggs and other harmful organisms. Lack of oxygen also aids in this destruction.

A method for the storage of horse manure so that sufficient heat is produced to destroy worm eggs has been worked out by the Bureau of Animal Industry with very satisfactory results, and it would probably be applicable to poultry manure. A double-walled, double-floored, wooden pit, with sawdust between the double parts of the walls and floor for insulation, with a tight cover to hold the heat, was found to be the best kind of storage pit; all parasitic-worm eggs were destroyed in a period of two weeks in horse manure stored in this manner. It is a common practice to store chicken droppings in barrels. If the barrels have a tight cover and a suitable external insulation to hold the heat, droppings which are not dried by the addition of sand or similar material may be expected to heat to the point where parasitic material is destroyed.

DISEASES CAUSED BY PROTOZOA

BLACKHEAD (ENTEROHEPATITIS)

Blackhead is primarily a disease of the intestines and liver, but the fact that the head of the bird affected often becomes discolored has given it its popular name, blackhead. It is most frequently seen as a disease in turkeys, but chickens also are susceptible. The ruffed grouse and bobwhite quail likewise have been found to suffer from the disease.

Cause.—The parasite (*Histomonas meleagridis*) causing blackhead is one of the Protozoa. The organisms live part of the time free in the cavity of the ceca, or blind guts, but in another stage of the disease they burrow into the walls of the ceca and are carried through the blood stream to the liver. The organisms in the ceca multiply in large numbers and pass out in the droppings.

Spread of the disease.—Young and adult chickens may contract this disease, but although in some outbreaks they may die in considerable numbers, they more usually recover promptly. However, in spite of their recovery, they remain carriers of the parasites, which are discharged in their droppings in vast numbers, from 20,000,000 to 40,000,000 of the organisms passing daily from one chicken. These organisms may infect other birds, either chickens or turkeys, if picked up by them in contaminated feed or water. The realization that turkeys may die, in large numbers, of blackhead contracted from chickens which have the disease in so mild a form as to show no evidence of it has led to strong emphasis being placed on the recommendation that turkeys be kept away from chickens.

It is probable that the parasite which causes blackhead was originally brought to North America in chickens from Europe and that it was passed on to turkeys in this country, thus introducing a new disease to which turkeys were more susceptible than was the chicken, which in the course of time had become resistant to it.

Another highly important factor in the spread of blackhead disease is the part played by the common cecum worm (*Heterakis gallinae*) of chickens and turkeys. The worms in the ceca of a fowl which is infected with the blackhead organisms may carry these organisms in their bodies; the eggs of the worm, which are passed out in large numbers in the droppings of the fowl, carry these small blackhead parasites within them. When the eggs are eaten, in contaminated feed or water, by a fowl and hatch in the fowl's ceca, the blackhead organisms are transmitted to the bird and set up the disease. The protozoan parasite, being thus included within the shell of the worm egg, is protected from heat, cold, dryness, and other adverse conditions which would otherwise destroy it. The worm eggs, which are resistant to such factors because of their thick shells, can hold the blackhead organisms in the soil from one year to another, whereas it has been found that the blackhead organism itself, without such protection, seldom survives for more than 24 hours outside the body of the fowl.

Symptoms.—The disease may occur at any time in the life of a turkey, but it is most prevalent in young birds. Droopiness, loss of appetite, an invariable loss of weight, and sometimes a sulphur-colored diarrhea are the main symptoms. The discoloration of the head, which has given the disease its name, is seen also in other diseases and is not always present in this disease, so that the term "blackhead" is not a very satisfactory term. Death may occur suddenly.

Internal changes.—An examination of the turkey after death shows the ceca, or blind guts, enlarged and filled with a solid, yellowish, cheesy mass; the walls of the ceca may have areas which are roughened and thickened. In addition to the changes in the ceca, the liver is often affected; it is enlarged and often spotted with dark-red, gray, or yellow areas, which are depressed below the surface rather than raised above it. (Fig. 18.)

Treatment.—Although many drugs have been tried and some are recommended for the treatment of blackhead, none have been found very satisfactory. The only drug known to be effective is tryparsamide, and the fact that it must be given by injections into the blood

stream in a carefully measured dose, and also that it is very expensive, makes it unsatisfactory for general use. The only practical, general procedure consists in the use of control measures to prevent the development of the disease.

Prevention.—Since, as explained above, the chicken may act as a carrier of the parasite causing blackhead disease, turkeys should be kept completely removed from chickens or land ranged by chickens or fertilized with chicken manure. Although observations made on turkeys indicate that turkey hens which had previously had the disease are unlikely to remain carriers of the blackhead organisms and so infect the poult, nevertheless in actual practice the best results are obtained with artificially reared birds—that is, those hatched in incubators and brooded artificially. The poult should be kept first in coops and runs that can be easily cleaned, and later on pasture that is known not to have been ranged by chickens and preferably not to have been used for older turkeys. The University of California has carried on cooperative projects with turkey raisers along these lines with considerable success, the losses among such artificially reared turkeys being much less than those of previous years under the old system.

The University of Nevada extension service recommends the tobacco-dust treatment of turkeys, when 2 months old, for cecum worms, since the worms play such an important part in spreading the parasite. Mash containing 2 per cent of ground tobacco may be fed for from one to two weeks at that time. The losses from blackhead are said to have been considerably reduced in localities using this treatment. Other treatments for cecum worms are given in this bulletin (p. 53.) Any turkeys which show symptoms of the disease should be promptly removed and isolated, and those which have died should be buried.

COCCIDIOSIS

Cause and nature of the disease.—For many years it was thought that minute protozoan organisms known as coccidia, found in a large variety of birds, both domestic and wild, were all the same species, *Eimeria avium*. As the result of recent studies, however, it has been found that there are at least six species of coccidia in chickens alone; four of these are disease-producers and two are not. One species, *E. mitis*, may live in the small intestine without producing noticeable damage to its wall and without seriously affecting the health or growth of the chicken. Another species, *E. tenella*, which is found in the blind guts, or ceca, of the chicken, affects the health of the bird very decidedly, producing the symptoms of coccidiosis as they



FIGURE 13.—Enteritis (blackhead). Liver of turkey, showing necrotic areas

are most widely known among poultry raisers. This is the acute form which is often seen in baby chicks during the first few weeks of life; the coccidia invade the wall of the gut and often produce extensive hemorrhages, blood being noticeable in the droppings. Other symptoms, which in fact may appear earlier than that of bloody droppings, are ruffled feathers, pallor, and rapid wasting. (Fig. 14.) Chicks up to 2 months of age may die very suddenly and in large numbers as a result of this form of the disease.

A serious chronic form of coccidiosis may be caused by another species, *E. acervulina*; the organisms in this case live chiefly in the upper part of the small intestine, producing whitish or grayish spots in the wall. Extreme emaciation or wasting of the fowls in severe cases is the principal characteristic of this form of coccidiosis.

Another coccidium, *E. maxima*, occurs in the middle or lower part of the small intestine, producing a thickening of the wall, with a variable amount of hemorrhage; however, the quantity of blood passed in the droppings is never so great in this disease as in that involving the ceca. In severe cases of this type, pallor, roughening of the feathers, and diminished appetite result.

E. praecox and *E. necatrix* occur in the small intestine. The latter is pathogenic and produces severe hemorrhage.



FIGURE 14.—Chick suffering from coccidiosis; cecal form

Infected with coccidia, *E. meleagridis* and *E. meleagrinis*, species different from those found in chickens. However, turkeys are not yet known to suffer from the presence of these organisms to any considerable extent; no outbreaks of coccidiosis are known among these birds. It is probable that the young poult develop an immunity to the organisms at an early date, as turkey poult may show the presence of these coccidia within the first week after hatching, but do not appear to be injured by them.

Pigeons are also parasitized by one of the coccidia; this is probably a still different species, but its identity has not yet been established. The disease produced in pigeons may be rapidly fatal or may be chronic. In geese, coccidia produce a disease of the kidneys which may weaken them so greatly that they are unable to walk; the birds become progressively weaker until they die.

Method of contracting the disease.—In all forms of coccidiosis, the disease is spread by contamination of the feed, water, and soil with the droppings of fowls which harbor the parasites. The coccidia pass through certain stages of development in the outside world (fig. 15, B and C); later, when taken in the body of a bird in the act of eating or drinking, the organism continues its development, multiplying in large numbers. (Fig. 15, A.)

As regards the transmission of coccidia to young birds through the egg, it appears never to have been demonstrated that the organisms may be included in the egg at the time it is formed. Even if such transmission were possible, it is improbable that it would happen frequently; it is much more likely that the organisms would be on the outside of the egg, the contamination of the eggshell occurring as the egg was passing out of the cloaca and vent. Turkey poult's have often been found to start passing coccidia in their droppings within a week after removal from the incubator, even when they had been carefully protected from acquiring the infection, so that the only source of the infection appeared to have been coccidia which were car-

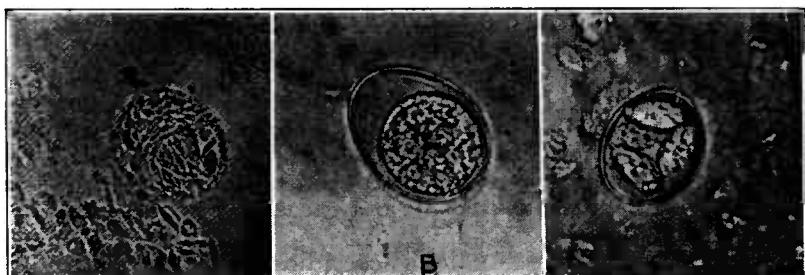


FIGURE 15.—Various stages of development of organisms which cause coccidiosis: A, manner in which one organism gives rise to a large number of organisms in cecum of fowl; B, organism as passed in the droppings of fowl; C, organism which has developed to a stage which will infect the fowl. (After Johnson, 1924)

ried on the eggshell. As regards chickens, however, it is probable that coccidiosis is contracted by the young chicks much more frequently by other means than by transmission through or on the egg.

The organisms may be carried for considerable distances in running water or in dust, or on shoes, grain sacks, or other objects, or may be spread by birds or by flies or other insects which fly from one poultry yard to another; rats and mice also probably serve to spread the organisms. It has been found that a single organism is capable of producing a mild form of the disease, the organism multiplying in the chick's body and considerable numbers of the parasite later being passed in the droppings, so that as a result the infection is capable of spreading to the other chicks. It is apparent, therefore, that there are many ways in which a small amount of the disease-producing material may be spread.

Post-mortem findings.—If the course of the disease has been short, as sometimes happens in the acute form of coccidiosis, with death occurring early, there may be no visible changes in the intestines; microscopical examination of the intestinal contents will show the presence of coccidia in some stage of development, however. If the disease is of longer duration, changes will have taken place, the

nature of which will depend on the species of coccidia present, as noted above. In the acute form of coccidiosis in which the site of infection is in the blind guts, or ceca, these organs may be enlarged and filled with blood, and in later stages the cavity of the cecum may be plugged with a thick core, a yellowish, cheesy substance with dark bloody areas in it.

Treatment.—Many treatments have been tried and advocated for coccidiosis but none have been completely satisfactory. This may be due partly at least to the fact that instead of one species of coccidia being involved, as was formerly thought, there are several.

No treatment offers great promise for the cure of fully developed cases such as those occurring in young chicks. Quinine sulphate, 1 teaspoonful to a gallon of water, furnished as the drinking water for the birds, has been reported as beneficial in some cases, but results of its use on a large scale are still needed before its value can be regarded as established. The same is true of some other drugs, as, for instance, carbon tetrachloride and also tetrachlorethylene, given in individual doses of 1 to 1.5 cubic centimeters, which in the relatively small number of cases treated have been found to be effective in greatly reducing the numbers of coccidia in birds acting as chronic carriers. These treatments need additional study before they can be recommended.

Catechu was formerly thought to be of value in the treatment of coccidiosis but critical tests have shown it to be ineffective. Cresol, formaldehyde, and areca nut, in each case given by mouth, are among other remedies shown to have no value in this respect. Prevention, as outlined below, seems to be the only feasible program known at present.

Prevention.—Extensive studies of coccidiosis have brought to light two important facts: (1) That the severity of the disease depends on the number of organisms which are taken into the body of the fowl, and, (2) that the disease runs a limited course. In nonfatal cases the fowls recover and the organisms usually disappear within a month's time, unless reinfection has taken place. Control measures which take these facts into consideration are therefore indicated.

Although there has been little success in the medicinal treatment of coccidiosis after it is fully developed, measures can be taken to prevent the development of the disease in chickens and to reduce its injurious effects if it appears. Strict sanitation, as described below, will reduce the number of organisms and a well-balanced, nutritious diet will help build up the resistance of the fowls.

The feeding of a mash containing 40 per cent dry skim milk or 20 per cent milk sugar has been reported by the California Agricultural Experiment Station as effective in protecting young chicks from coccidial infection, the mash being fed during the period when the chicks are from 4 to 8 weeks old. The results of the use of this diet, however, have not been entirely consistent; in some cases it has failed to check the disease and even has appeared to produce injurious effects, such as pronounced diarrhea with more or less prostration. The addition of egg rather than milk to the diet has been recommended as fulfilling the need of a tempting, nutritious diet for the chicks. Recent experimental work indicates that a well-balanced diet, rich in vitamins, is of value in the control of coccidiosis.

Daily cleaning is highly advisable, in order that the organisms which are being passed in the droppings may be prevented from developing to the stage which is infective. As a disinfectant for houses and yards, a 2 to 4 per cent solution of liquor cresolis compositus or other coal-tar creosotes used in strong, hot solutions may be helpful; the coccidia, however, are very difficult to destroy, so that cleanliness and the frequent removal of droppings containing the infectious material are more effective than are measures which aim to destroy the organisms. Dependence must be placed on cleaning rather than on chemical disinfection, and disinfectants must be regarded only as aids in connection with cleaning up. Coccidia need moisture for their development, hence thorough drying checks this development. They are susceptible to high temperatures also, boiling water destroying them quickly and hot water of somewhat lower temperature more slowly (a temperature of approximately 130° F. kills them in about 30 minutes). Practical measures based on these principles include: (1) Burning over the ground or runs; (2) the application of a layer of slaked lime to the ground; (3) putting feeding troughs and drinking vessels into boiling water at frequent intervals; (4) burning carcasses of fowls which have died of the disease; and (5) burning or removing to remote areas the litter or other refuse which may be contaminated with infected droppings.

Raising chicks on raised wire-mesh floors, through which the droppings will fall, is probably the most effective preventive measure, but birds raised in this way must be kept away from infection subsequently, as they do not have the acquired resistance of birds which have passed through an attack of coccidiosis in early life. The screening of houses and runs in order to keep flies out and thus prevent their spreading the organisms is also of value.

TRICHOMONIASIS

Chickens may occasionally suffer from another disease, known as trichomoniasis, caused by a protozoan, *Trichomonas* sp., in the ceca; the disease, however, appears to be relatively less common and less severe than those previously described. Young chicks up to a month of age may die of the infection. The mildness or severity of the disease may vary with different strains of the organisms that cause it. The feeding of sour milk is said to be of value in the treatment of this disease.

PIGEON MALARIA

Cause.—A protozoan parasite, *Haemoproteus columbae*, which lives in the blood of pigeons, invading the red blood corpuscles, is the cause of pigeon malaria.

Spread of the disease.—Pigeon malaria is spread by the pigeon fly, *Pseudolynchia maura*, the latter being necessary for the transmission of the parasite from one bird to another. The fly in biting takes in the parasites with the blood of the bird; the parasites multiply and develop within the insect's body and are then introduced into a bird in the bite of the fly.

Symptoms.—The destruction of the red cells by the parasites may cause anemia, a condition in which the blood becomes less red, this

in turn lowering the vitality of the birds. Aside from this there are no marked symptoms.

Prevention.—Prevention consists in the destruction of pigeon flies. The Bureau of Entomology recommends a thorough cleaning of the pigeon nests at intervals not to exceed 25 days, using a light spray of kerosene extract of pyrethrum in the interior of buildings, and one of the following procedures: Dusting the squabs and pigeons with fresh pyrethrum powder, Derris powder, or tobacco powder

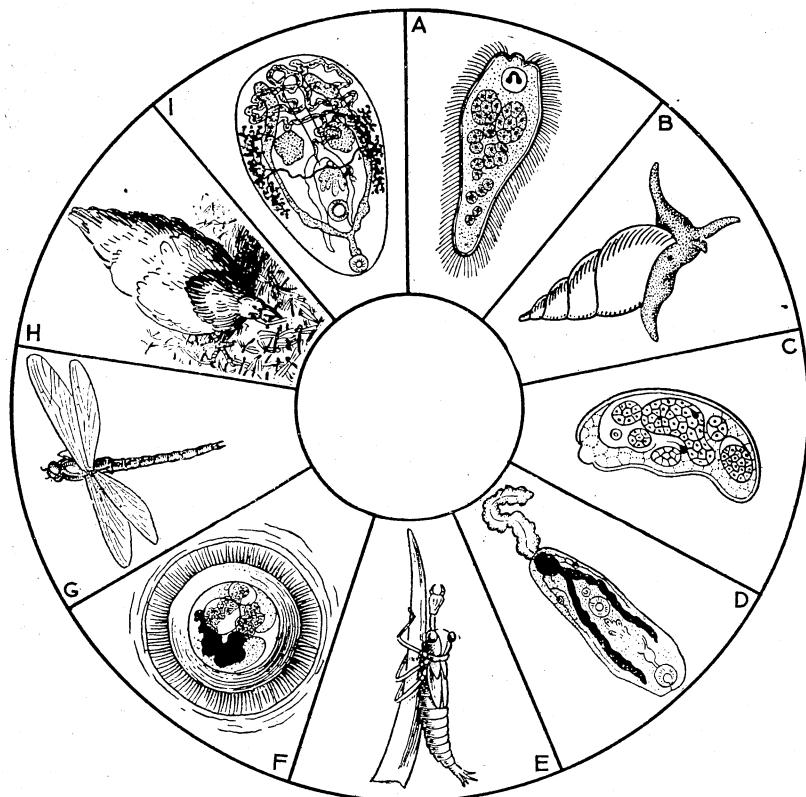


FIGURE 16.—Life history of fluke which attacks egg-forming organs of chicken.
(After Szidat, 1929)

containing about 6 per cent nicotine; dipping them with either an aqueous extract of pyrethrum with soap or Derris extract with soap and water; or using the kerosene extract of pyrethrum spray on the birds.

WORM PARASITES AND THE DISEASES CAUSED BY THEM

FLUKES

Flukes are small, flat worms, more or less resembling a leaf in shape. Their life histories always involve at least one intermediate host and sometimes two. There are two different kinds of flukes which have been found to cause disease in poultry in the United

States and, although they are as yet rare in occurrence, they should be kept in mind as of possible importance in the future.

FLUKES CAUSING INJURY TO THE EGG-FORMING ORGANS

Parasite and damage produced by it.—One species, *Prosthorogonimus* sp., which has been found in chickens in Michigan, is reddish in color and about a quarter of an inch long. Such flukes usually occur in the cloacal region, but they may invade the egg ducts and ovaries, causing serious injury to those organs. The symptoms shown by the fowls are dullness, loss of weight, and pallor. In Europe, closely related parasites have caused serious losses among chickens. It occurs always in the neighborhood of lakes or marshy places, such an environment being essential in its life history. The flukes may occasionally be found in eggs laid by infected hens.

Life history of parasite.—The life history of this parasite involves snails and also dragon flies, as shown in Figure 16. The young worm (A), which hatches from the fluke egg, develops partially in the snail (B), to a form of different appearance (C); then, leaving the snail as a tailed form (D), it swims around and burrows into the body of the young stage of the dragon fly, which lives in the water during its early life (E); in the insect the parasite forms a cyst (F); and, when the dragon fly is fully grown (G) and is eaten by the chicken (H), the worm develops to its adult form (I), from which the fluke eggs pass and begin the cycle again.

The parasite has been found in wild ducks and, therefore, it probably may be spread by them to domestic fowls.

Treatment and prevention.—Repeated doses of carbon tetrachloride, from 1.5 to 1.7 cubic centimeters of the drug, given in liquid cereal, are reported as a successful treatment for this parasite. To prevent chickens from becoming infected in an area in which the parasite occurs, measures should be taken to keep the fowls from eating dragon flies. Chickens probably capture the flies when the latter are still cold and inert in the early morning, and keeping fowls away from areas where these insects occur until the air has warmed would probably help to keep down infection. Otherwise, fowls should be kept away from wet places.

THE CYSTIC FLUKE IN THE SKIN

Another fluke, *Collyriclum faba*, has been found in cysts in the skin of chickens in two widely separated flocks in Minnesota. In addition to injuring the general health of the fowl, the parasites produce blisters in the skin, the disfigurement reducing the market value of the fowl.

The parasite occurs also in the English sparrow and is probably spread by that bird. The life history is unknown.

TAPEWORMS

Description of parasite.—Tapeworms, or cestodes, are flattened worms made up of numerous divisions or segments, following a head region by which the tapeworm is attached to the intestinal wall. The tapeworm grows at the neck region, just behind the head, so that the segments farthest from the head are the oldest ones. When

the tapeworm is fully developed, these oldest segments are filled with eggs and are spoken of as ripe or gravid segments; it is these segments which break off from the remainder of the worm and are passed in the droppings.

At least eight different species of tapeworms are found in this country in chickens, an equal number in turkeys, and several other species in the other domestic birds, such as ducks, geese, pigeons, and guinea fowls. The tapeworms vary much in size (fig. 17), some being so small that they are seen or found only with difficulty, whereas others measure several inches in length.



FIGURE 17.—Seven different species of tapeworms from the chicken. Natural size

Method of spread of tapeworms.—Tapeworms of poultry must pass part of their life history in an intermediate host, so far as these life histories have been definitely ascertained. This host is some small form of animal life which is eaten by poultry, either accidentally with feed or water, or actually as one of the items of feed. In the case of some of the tapeworms of poultry the nature of the intermediate host is as yet unknown, but in other cases it has been definitely ascertained that dung beetles, ground beetles, the house fly, snails, slugs, and earthworms serve as hosts for various chicken tapeworms; grasshoppers probably serve for one of the turkey tapeworms.

Damage done by tapeworms.—One of the larger tapeworms, *Davainea echinobothrida*, found in chickens produces in the intestine, especially in the lowest third of its length, numerous protuberances or nodules, which closely resemble the nodules caused by tuber-

culosis. If tapeworms are attached by the head to the inner surface of the intestine at the site of the nodule, such a condition may be ascribed to the worms. If tuberculosis also is present there will probably be lesions in the liver.

In the case of other tapeworms, however, the injury to the intestinal wall is not so marked. Loss of weight, loss of appetite, a general condition of droopiness or unthriftiness, intestinal catarrh, and diarrhea are the conditions most frequently found associated with the presence of tapeworms. Young fowls are most seriously affected. Occasionally, lameness and paralysis have been associated with heavy infestations with certain tapeworms. If these conditions are caused by tapeworms, the removal of the worms will clear up the condition, but the same conditions may be caused by other things, and the finding of tapeworms associated with these conditions does not prove that there is a connection between them.

Treatment.—Kamala is the drug which has been found to be most effective in the removal of tapeworms of poultry. Kamala is a brownish powder and is marketed in one form as a tablet, usually as a 1-gram tablet.

The drug should be used with caution; a few fowls from a flock should be treated first, to determine the effect, before all are treated. The use of kamala for chickens and turkeys has occasionally had unfavorable results, such as loss of appetite, the lowering of egg production, and even the occurrence of deaths among the fowls, especially turkeys; the reason for such results, when millions of doses have been administered with no bad effects, is unknown but one should not use kamala on birds which have blackhead, coccidiosis, white diarrhea, roup, or other diseases which lower the birds' resistance.

The average dose for a full-grown chicken is 1 gram but this should be reduced if the fowls are in a weakened condition; for chickens that are not fully grown, only a half dose should be given. For turkeys, a 1-gram dose is advisable unless the birds are especially large and are known to tolerate the drug well, in which case a 2-gram dose may be given; for poult's a reduced dose is preferable.

Prevention.—To prevent the spread of tapeworm disease among poultry, the droppings of the fowls should be disposed of in such a way that the known intermediate hosts of the parasite, such as beetles, flies, slugs, snails, and earthworms, are kept from eating the eggs or segments of tapeworms passed in the droppings of infested fowls; and poultry should be prevented from eating these intermediate hosts which may be carrying larval stages of tapeworms. Prompt removal of droppings, keeping the yards and houses free of trash, boards, boxes, and other unnecessary objects, and the filling in or liming of damp places near feed and water vessels, which places may serve as hiding or breeding places for the intermediate hosts, are valuable preventive measures. Spading or plowing up of pens or runs and seeding them to vegetation, such as clover or other short green stuff, rather than leaving them in a weedy, fallow condition, has been helpful in reducing the number of ground beetles which may serve as intermediate hosts.

In some places poultymen have resorted to raising chickens in confinement, under screen, and on raised floors, in order to prevent their

becoming infested with tapeworms. Certain of the beetles, however, which are known to serve as intermediate hosts are considerably smaller even than house flies, so that in case of screening the mesh of the screen must be fine enough to keep out such small insects, to be thoroughly satisfactory.

In order that poultry droppings may not be wasted but may be used for manure, without danger of spreading worm infection, it is recommended that the droppings be stored for a while, as previously described.

ROUNDWORMS

EYE WORM OF POULTRY

The parasite, *Oxyspirura mansoni*, known as Manson's eye worm, is known to have been present in Florida for many years and has recently spread to Louisiana. It occurs in chickens, turkeys, and peafowls, and can develop in various wild birds. The parasite is found under the nictitating membrane, that is, the transparent membrane which passes over the eyeball of the fowl in the act of winking. The worms are slender and colorless and are about three-fourths of an inch long; they can often be detected by a firm pressing of the tear sac at the inner corner of the eye, when they will wriggle out over the eyeball.

Symptoms and damage produced by parasite.—Affected fowls wink the eye continuously and frequently attempt to rub the head on the feathers of the wing, or to scratch at the eye with the foot. The eyesight is not good. There is puffiness around the eye, and a discharge from the eye and from the opening of the nose. There is often a severe inflammation which may result in blindness; at times the entire eyeball is destroyed.

Life history of parasite.—This roundworm has an indirect life history, and its intermediate host has been shown by workers of the Florida Agricultural Experiment Station and elsewhere to be a cockroach, *Pycnoscelus surinamensis*. The cockroaches are found beneath boards and trash and in the vegetation at the edges of the fences; they feed on whatever food material is present, including the droppings of the fowls. From the droppings the cockroaches obtain the eggs or newly hatched larvae of the roundworms, the eggs having been washed down the tear ducts from the eye of the fowl and having then been swallowed and passed in the droppings. The young roundworm develops in the body of the cockroach and when the roach is eaten by a fowl the worm is freed in the bird's crop. It passes up the esophagus to the mouth and then through the tear ducts to the eye.

The cockroach which spreads the parasite in this manner in Florida and Louisiana also occurs in Texas, and in certain places in the North it has been found in greenhouses. There is danger, therefore, that the eye worm may spread to States other than Florida and Louisiana. By the feeding of cockroaches containing the young stages of the worms, the eye worm has been experimentally developed in ducks, bobolinks, a blackbird, a pigeon, a loggerhead shrike, and a blue jay; such birds as these must, therefore, be considered possible carriers of the roundworm in areas in which it is found in poultry.

Prevention.—The removal from the chicken yard and houses and from the area around the yards, of all trash, boards, boxes, and other

unnecessary objects, which may serve as hiding places of cockroaches, is probably the most important control measure. Roaches which come from the outside into a clean yard, free from objects which may serve as hiding places for them, are likely to be eaten promptly by the chickens before the roaches have a chance to become infected by eating the chicken droppings. Such uninfected roaches will not cause worm infestation. Hiding places enable the roaches to become infested and to infect the chicken which subsequently captures them. The daily collection of droppings and their removal to a place where cockroaches can not get at them is a measure of value. Affected birds should either be treated and cured or killed and destroyed.

Treatment.—The Florida Agricultural Experiment Station recommends the following as the most effective treatment: Drop into the eye of the fowl a 5 per cent solution of butyn as an anaesthetic; then, lifting the nictitating membrane of the eye, place 1 or 2 drops of a 5 per cent solution of creolin directly on the worms. Immediately after applying the creolin, wash it out well with water; the worms will have been promptly killed by it.

GAPEWORM OF CHICKENS AND TURKEYS

A roundworm which produces unmistakable symptoms of disease is the gapeworm, *Syngamus trachea*. This parasite occurs in turkeys and chickens but with a decided difference in effects. As a rule, the gapeworm will live in chickens only when the chickens are very young, the first few weeks of life being the danger period. The chicks that live through the acute stage of gapeworm disease soon lose the worms, and, therefore, do not remain carriers. On the other hand, adult as well as young turkeys commonly harbor gapeworms and usually show no bad effects, and it is apparently the infested turkey that is the chief cause of the spread of gapes to chicks. Exceptionally young turkey poult's suffer from gapes and very exceptionally gapeworms may be found in a mature chicken.

Gapeworms are attached to the wall of the windpipe or trachea, on its inner surface. (Fig. 18.) The male and female worms are joined together so that the two worms form a Y.

Symptoms and damage produced by parasite.—The worms clog the windpipe of chicks, and because of an insufficient supply of air young chicks which have gapeworms in the windpipe will open the beak and gape; this behavior has given rise to the name "gapes," as applied to the disease. There is often a convulsive shaking of the head, with a hissing cough. This continuous effort to obtain air prevents the chicks from feeding; this and also the fact that the worms are bloodsuckers weaken the chickens so that they become



FIGURE 18.—Gapeworms in windpipe of chick. (After Hall, 1916)

thin and pale. Death may result from suffocation or from general weakness.

Life history of the parasite.—This parasite has a direct life history. Eggs of the parasite are coughed up from the windpipe and swallowed by the chicken or turkey which harbors the worms. These eggs pass out in the droppings, develop, and some of them hatch. Either the infective eggs or the young roundworms which hatch from them may then be swallowed by fowls in the act of feeding or drinking. Within a week the young worms will have reached the lungs, and from there they work their way up into the windpipe and may be fully developed within another week or 10 days.

Earthworms may play an important part in the spread of gapes. The infective eggs or the young gapeworms which have hatched in the soil from the eggs in the fowls' droppings may be eaten by earthworms; they burrow into the body muscles of the earthworm and may remain alive for considerable periods. The earthworm in these cases is not a necessary intermediate host of the parasite; it is merely a mechanical carrier or reservoir, protecting the young gapeworms from conditions such as drought and high and low temperatures, conditions which would otherwise kill the young parasites. Earthworms may thus carry the young gapeworms over from one warm season to another.

Another important factor in the spread of gapes is the fact that turkeys may carry gapeworms throughout their whole life and thus may spread them to young chickens, if turkeys and chickens are being raised together.

Prevention.—Raising young chicks entirely separate from turkeys and areas ranged by turkeys is the most important preventive measure. If gapeworm disease has been present in the vicinity, dry, sandy soil should be selected for young chicks to run on, since such soil is unfavorable to earthworms; or young chickens should be shut up until the dew has dried off in the morning, when most of the earthworms which have come to the surface will have disappeared.

Treatment.—No treatment has been found to be thoroughly satisfactory. Mechanical removal, although a slow, difficult, and rather dangerous procedure, may be accomplished by the insertion of a loop of horsehair down the windpipe and the rotation of the loop in such manner as to dislodge the worms from the wall and entangle them in the hair, which is then withdrawn. A small quill feather, which is stripped of all its web except a small tuft at the end, may also be used in place of the hair; a little kerosene or oil of turpentine put on the feather will aid in loosening the worms and later will cause the chick to sneeze or cough and thus help to bring up the worms. Wire extractors made by commercial firms are used in the same manner.

Various medicinal treatments have been advocated, but none can be regarded as of proved value.

CROP WORMS

There are two different kinds of roundworms which occur in the crop, and occasionally also in the undilated esophagus, of chickens and turkeys. Both kinds are sewed into the walls and have the ap-

pearance of a wavy, white thread. The worms move around inside the wall and form burrows or tunnels.

One of these roundworms, *Gongylonema ingluvicola*, is comparatively rare, and is not known to injure the health of the fowl aside from slight local damage to the wall of the crop. This roundworm has an indirect life history, the intermediate hosts being dung beetles.

The second crop worm, *Capillaria annulata*, has been found more recently in this country, but appears to be of much more common

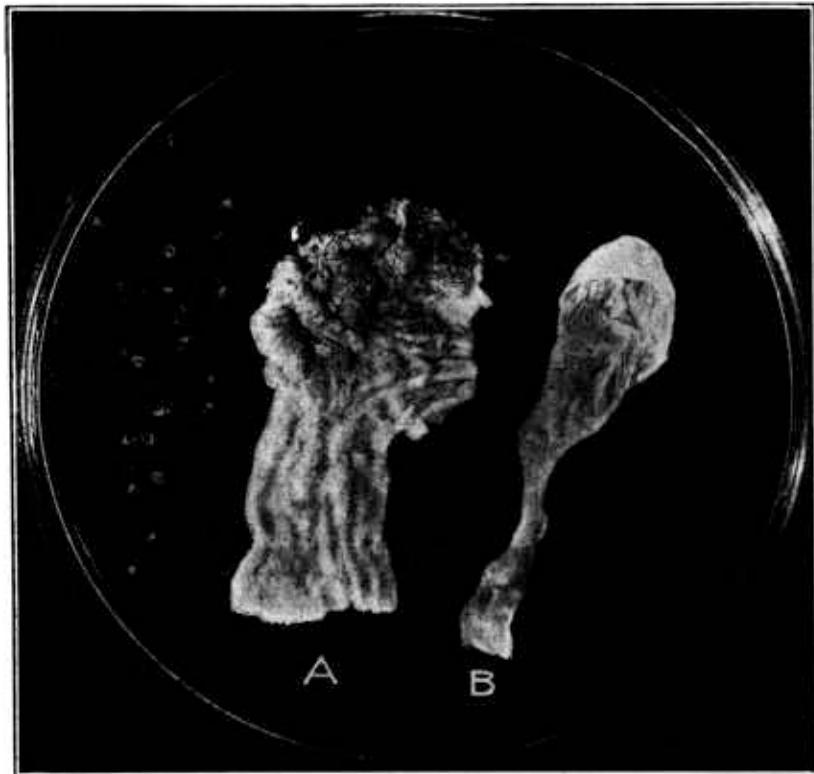


FIGURE 19.—Left, a crop heavily parasitized by the crop worm, *Capillaria annulata*. Right, a normal crop. Note, on the extreme left, the threadlike worms which caused the injury.

occurrence. In severe cases these roundworms may be present in large numbers and may greatly damage the walls of the crop and the undilated esophagus. (Fig. 19.) They interfere with digestion, and the fowls become progressively weaker and finally may die from the effects of the parasite. This roundworm probably has a direct life history, the eggs which pass out in the droppings developing to a stage which will infect the fowl swallowing them in contaminated feed or water. This life history has not yet been experimentally demonstrated, but in the case of a closely related species, *C. contorta*, which occurs in domestic ducks in Europe and

in wild ducks and gallinaceous game birds (pheasants) in this country, direct, experimental transmission from one bird to another has been accomplished.

Prevention of crop worms.—General sanitary measures such as described on page 33 are advised.

Treatment.—The feeding of soft, highly nutritious feeds in place of grain is of value in overcoming the effects of crop worms. No medicinal treatment has yet been developed. Worms which have burrowed into the crop are more or less protected from the action of drugs. Carbon tetrachloride or tetrachlorethylene in fairly large doses (from 2 to 5 cubic centimeters), given when the crop is empty, may be of value if the damage to the wall of the crop has not been too severe. (See p. 51 for administration of these drugs.)

STOMACH WORMS

In the two stomachs of domestic birds, that is, in the proventriculus or glandular stomach and in the gizzard or muscular stomach, several different kinds of roundworms may be found.

THE TETRAMERE OF CHICKENS

This parasite, *Tetrameres americana*, shows very strikingly differences from most other roundworms. The usual slender, elongated form of roundworms is lost in the case of the female tetramere. (Fig. 20.) While young these parasites enter the glands of the stomach and as they develop to adults the large number of eggs which form within the body causes it to swell until it is practically globular in shape; also, its color changes to bright red. These parasites may be present in adult fowls without any apparent injury to the health of the fowl. In young chicks, however, they interfere with the proper digestion of food, so that general weakness and diarrhea, and even death, may result.



FIGURE 20.—A tetramere from the glandular stomach of a chicken. Enlarged about four times.

Life history.—The tetramere has an indirect life history and the intermediate hosts have been found to be grasshoppers and cockroaches.

Prevention.—Raising young chicks in such a way that they can not feed on grasshoppers or cockroaches which may have had access to the droppings of older, infected chickens, and disposing of droppings so that the worm eggs in them are destroyed or that insects can not get at the droppings, are the most important preventive measures.

Treatment.—A soft, highly nutritious feed, rich in vitamins, has been found to help chicks to overcome the bad effects of this parasite. No medicinal treatment is known; that suggested above for crop worms may be of value in this connection.

THE SPIRAL STOMACH WORM

A short, white roundworm, *Disparynx spiralis*, which is curved or even twisted in a spiral, is found occasionally in the glandular stomachs of chickens, turkeys, and pigeons, as well as in gallinaceous game birds, in this country, and if present in considerable numbers

may seriously affect the health of the bird. The more evident symptoms are droopiness and loss of weight, in spite of the fact that the birds have a ravenous appetite even up to the time of death. In pigeons the eye has been said to lose its color when the birds are suffering from the effects of this stomach worm. The stomach may be considerably enlarged and the glands of its wall may be partly or almost completely destroyed.

Life history.—This roundworm has an indirect life history, and sow bugs, or pill bugs, have been found to be the intermediate hosts.

Prevention.—Measures which will eradicate sow bugs from the premises, so that the birds can not eat them, are of great importance. Keeping the birds in dry, light quarters and the removal of unnecessary objects under which the sow bugs may hide are of value in this connection. The proper disposal of droppings, either to destroy worm eggs or keep them from all intermediate hosts, is important.

Treatment.—No satisfactory treatment is known, although that suggested previously in the case of the tetramere, and also in the case of crop worms, may be of value.

GIZZARD WORM OF CHICKENS AND TURKEYS

A slender, white, gizzard worm, *Cheilospirura hamulosa*, about one-half to three-fourths of an inch long, has been the cause of deaths of chickens in this country, and has also been found in turkeys. It passes through the horny lining of the gizzard, leaving small, round holes with raw, raised edges (fig. 21), and burrows into the muscular wall, producing tunnels in the wall or causing the formation of wart-like growths on its surface. Eggs of the parasite pass out of the holes and mix with the gizzard contents, eventually being discharged by the bird in its droppings. The wall of the gizzard may be so badly damaged by these worms that the digestion of food is interfered with, and the health of the fowl consequently suffers from it.

Life history.—This roundworm has an indirect life history and its intermediate hosts have been found to be grasshoppers.

Prevention.—Sanitary measures, such as frequent collection and proper disposal of droppings so that grasshoppers may not feed on them and thus become infected with the early stages of the roundworm, and secondly, measures to prevent the fowls from eating grasshoppers, are advised. Confining fowls to runs which have been sown to a short, thick, green vegetation, such as grass, rather than allowing them to range in long, dry vegetation which is favorable to grasshoppers, helps to reduce the number of these insects eaten by the fowls.

Treatment.—Unknown; that suggested for the tetramere and for crop worms may be of value in this connection.



FIGURE 21.—Holes made by gizzard worm in the horny lining of gizzard of chicken

THE GIZZARD WORM OF DOMESTIC GEESE AND DUCKS

In domestic geese and ducks a small, slender roundworm, *Amidostomum anseris*, sometimes reddish in color from blood which it has swallowed, may be found burrowing in the horny lining of the gizzard; it does not invade the wall to so great an extent as does the gizzard worm of chickens and turkeys, but causes more damage to the surface. There is considerable loss of blood by the bird, and the gizzard lining shows roughened areas stained brown from blood. The parasite may produce poisons which also weaken the bird. Numerous deaths may occur in flocks in which these parasites are present in large numbers.

Life history.—This roundworm has a direct life history. The eggs pass out in the droppings, young roundworms hatch from them, and, after being taken in by the birds in the act of eating or drinking, the worms develop to adults in the gizzard. This parasite has been transmitted experimentally from the domestic goose to the domestic duck in this manner.

Prevention.—Sanitary measures which prevent the contamination of feed and water with the droppings of infected fowls are of value.

Treatment.—This parasite has been successfully removed from young geese by administering to each bird a 1.5 to 2 cubic centimeter dose of carbon tetrachloride, given in about 8 cubic centimeters (about 2 teaspoonfuls) of liquid cereal.

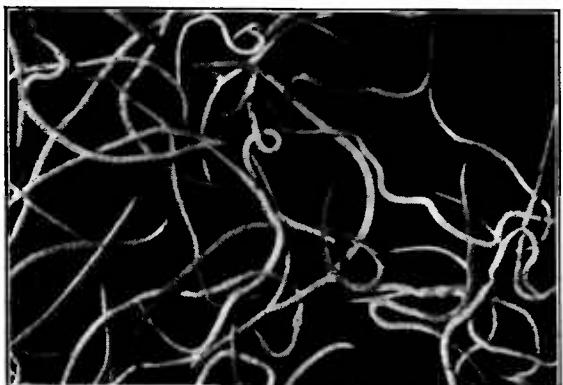


FIGURE 22.—Roundworms (*Ascaridia lineata*) from the small intestine of a chicken. (Courtesy J. E. Ackert)

centimeter dose of carbon tetrachloride, given in about 8 cubic centimeters (about 2 teaspoonfuls) of liquid cereal.

INTESTINAL ROUNDWORMS

THE LARGE ROUNDWORM OF THE INTESTINE

The large roundworm or ascarid, *Ascaridia lineata*, found commonly in chickens and less commonly in domestic ducks, geese, and turkeys, occurs in the small intestine and attains a length of from 1 to 4½ inches when fully grown. (Fig. 22.) These worms may be present in such numbers as to block the intestines. Large numbers of the young worms may kill chicks in from 10 to 12 days. The parasites stunt the growth of the chick and prevent proper bone development, so that weakness results. (Fig. 23.) Young chicks are most seriously affected by this roundworm. If the chick does not become infected until after it is 3 months old, the parasites do less damage to it. Grown fowls which harbor this parasite may be unthrifty and their egg production low.

The adult worms occasionally wander up the oviduct and are trapped in the hen's egg as it forms.

Life history.—The life history of this parasite is direct. The eggs of the parasite pass out into the soil in the droppings of the fowl and the young stage of the worm develops within them in a period of about 15 to 20 days, under favorable conditions. The young worm hatches from the egg when the latter is swallowed by a fowl. The young worms may burrow into the inner surface of the wall of the intestine, causing damage to the glands, for a period extending from about the tenth to the twentieth day after the egg is swallowed. Then the worms return to the interior of the intestine to develop into adults in about two months.

The eggs of the parasite are thick-shelled; they are resistant to cold but more easily killed by heat. In Kansas, the high temperature of summer has been found to kill all the eggs of this parasite on the surface of the soil and to a depth of 6 inches in unshaded places, but in shaded spots the eggs survived.

Prevention.—General sanitary measures should be adopted to prevent the worm eggs from developing in the soil and later being swallowed by the fowls. Rotation of runs has been found valuable. Special protection of chicks until they are 3 months of age, by raising them away from older chickens or areas ranged by such chickens, will prevent the greatest injury. A nutritious diet, rich in vitamins, has been found to be helpful in building up the resistance of the chick to this parasite.

Treatment.—The quickest and most effective treatment for the removal of the large roundworm consists in the individual dosing of each bird with carbon tetrachloride or the closely related drug, tetrachlorethylene, using a 1-cubic centimeter dose for adult birds; for young chickens, however, the dose must be reduced and given with caution. The drug is most easily given in gelatin capsules, although it may be introduced directly into the crop through a soft-rubber tube passed down the esophagus. Care must be taken that the drug does not get into the lungs, as in that case it may be quickly fatal. When both large roundworms and tapeworms are present, a 1-cubic centimeter dose of tetrachlorethylene, followed in three days

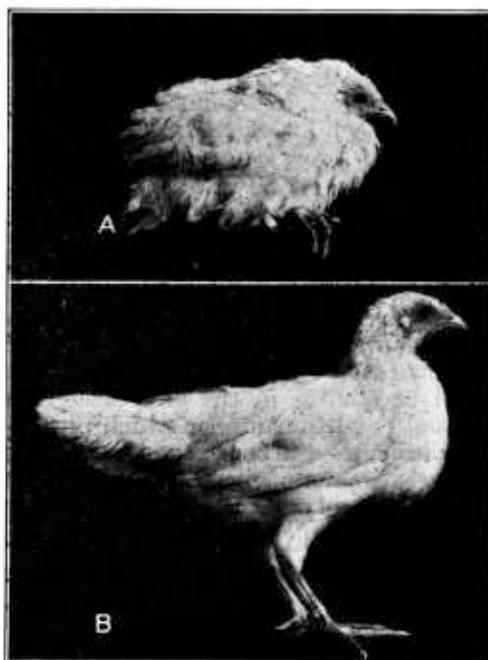


FIGURE 23.—A, Chicken suffering from large roundworm of the intestine, unable to recover from parasitism. B, control from same hatch; aged nearly four months. (After Ackert and Herrick)

by a 1-gram dose of kamala, is a satisfactory treatment for removing both kinds of parasites.

Another individual treatment consists in the administration, to each bird, of a No. 2 capsule containing 0.35 gram of a mixture of 6.6 cubic centimeters of 40 per cent nicotine sulphate and 16 grams of Lloyd's alkaloidal reagent, which is a selected fuller's earth.

For mass treatment rather than individual treatment the California Agricultural Experiment Station recommends the following:

Add to the mash 2 per cent by weight of tobacco dust containing at least 1.5 per cent nicotine, and feed this mixture to the flock for a period of three or four weeks. Treatment may be repeated at 3-week intervals as often as necessary.

If a single-dose treatment is desired for the removal of the large roundworm, the California station recommends the use of 1 teaspoonful of oil of chenopodium, thoroughly mixed with a moist mash, for each lot of 12 birds.

THE LARGE ROUNDWORM OF PIGEONS

In the intestine of pigeons may be found a large roundworm which closely resembles that found in chickens, but it is a different species, *Ascaridia columbae*. This parasite may be present in large numbers, as many as 500 having been collected from one pigeon. The worms are sometimes found to have wandered into the stomachs and even up into the esophagus. The life history is probably similar to that of the large roundworm of chickens and preventive measures would be similar in the two cases, with modifications to meet the different conditions under which pigeons are raised.

Treatment.—Carbon tetrachloride in repeated doses of from 1 to 2 cubic centimeters, given in liquid cereal or in liquid paraffin, has been satisfactory for the removal of this parasite. The pigeons may occasionally regurgitate the drug.

THE COMMON CECUM WORM, OR HETERAKID, OF POULTRY

The common cecum worm of poultry is also known as the heterakid, *Heterakis gallinae*; it occurs in the ceca, or blind guts, of chickens, turkeys, guinea fowls, and domestic ducks and geese. This worm attains a length of from three-tenths to one-half inch. The worms are sometimes present in enormous numbers and may cause a serious inflammation of the ceca, especially in young chicks. As already noted, they are apparently involved in the transmission of blackhead in the presence of infective blackhead material.

Life history.—The life history of this roundworm is direct, the eggs developing in the soil in a period of from 7 to 12 days under favorable conditions. They are very resistant to freezing and to drying. The young worm hatches from the egg when it is swallowed by a fowl. The young worms invade the wall of the ceca for a short period, and may do considerable damage at this stage; later they return to the interior of the ceca and develop to adults in about 24 days after entering the fowl's body.

Earthworms may be a factor in spreading cecum worms and other worms; the eggs of the roundworms may be eaten by the earthworms and later reach fowls by being passed in the casts of the earthworms and thus infecting otherwise uninfected soil, or by the earthworms being eaten by the fowls.

Prevention.—As in the case of the large roundworm, general sanitary measures, rotation of yards, and special protection of young chicks are of value in preventing infestations with this parasite.

Treatment.—The tobacco-dust treatment for the large roundworm will remove about 80 per cent of the common cecum worms, if continued for a month.

An individual treatment, which will remove about 90 per cent of the worms, consists in the use of rectal injections of oil of chenopodium in a bland oil, such as cottonseed oil. The dose is 0.1 cubic centimeter of oil of chenopodium in 5 cubic centimeters of cottonseed oil for a bird weighing $1\frac{1}{2}$ pounds. Probably double this dose would be effective for a bird weighing 3 pounds or more. This mixture may be made up at the rate of 1 teaspoonful of oil of chenopodium in 6 fluid ounces of cottonseed oil and given at the rate of one-third of an ounce to birds weighing 3 pounds or more, using a proportionately smaller dose for smaller birds. The two ingredients should be thoroughly mixed and given with a hard-rubber enema syringe. It is as easy to give this treatment by rectum as it is to give a treatment by mouth. The tip of the syringe should be passed along the floor of the cloaca, which is the common passage into which the intestine and the egg tube open, and the mixture injected slowly.

OTHER ROUNDWORMS OF THE INTESTINES

There are several different species of hairworms, or capillarids, *Capillaria* spp., which occur in the small intestine and ceca of domestic poultry, all kinds of domestic birds being known to harbor such worms at times. The worms are very slender and colorless, usually from one-half to three-fourths inch long, and are found with difficulty unless present in large numbers. They may seriously affect the health of the fowls. Carbon tetrachloride given in a 1-cubic centimeter dose, and repeated about seven days later, has been effective in removing some kinds of capillarids. The life history is direct and general sanitary measures should be adopted to prevent reinestation.

In pigeons a serious disease may be caused by a delicate, slender roundworm, the pigeon strongyle, *Ornithostrongylus quadriradiatus*, which occurs in the small intestine. The worms are bloodsuckers, and the loss of blood by the bird is probably responsible for the severity of the effects of this disease. A treatment which has been reported as effective in expelling these worms consists in giving each pigeon 5 centigrams of thymol, 3 doses being given on alternate days and followed by a capsule of castor oil.

In chickens an extremely small roundworm, the chicken strongyloides, *Strongyloides avium*, has been found in the ceca; in young chicks especially, it may seriously affect the health. The walls of the ceca may be greatly thickened and a bloody diarrhea may be present. If the chicks survive this acute stage, they may show no bad effects from the parasite, even though it is present, when the chickens are fully grown. The life history of this parasite is direct, but, unlike the direct life histories of other roundworms of poultry, this one includes stages in which the worms develop in the soil to adult males and females, which give rise to young. No treatment has yet been developed for removing this parasite. Special protec-

tion of young chicks and general sanitary measures are of value in preventing the spread of the parasite.

LICE

There are at least seven different species of lice occurring on domestic chickens, while still other forms occur on turkeys, ducks, and guinea fowls. As different species of lice are usually confined to different parts of the body and feathers, they are commonly referred to as head lice, wing lice, body lice, shaft lice, and fluff lice, although the distinction is not very exact, since the various species intermingle to some extent.³

LICE ON CHICKENS

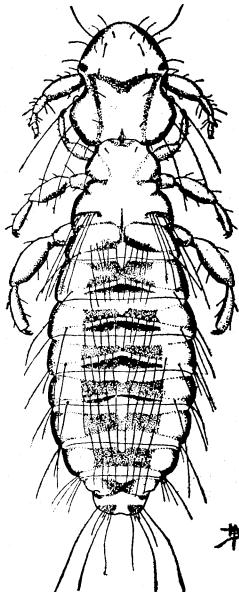


FIGURE 24.—The head louse, male, top view. Greatly enlarged.

The two most important lice on chickens are the head louse, *Lipeurus heterographus*, and the body louse, *Menopon biseriatum*. The head louse (fig. 24) is most injurious to young chicks. It occurs on the head at the base of the feathers or the down; it passes readily from one chicken to another, and from the hen to her chicks. It is important to treat the hen for lice before the hatch comes off. Treatment, as given below, should be applied to the head. The body louse is most injurious to grown fowls but occasionally affects young chicks. It causes irritation to the skin, with at times the formation of scabs or blood clots. It is found directly on the skin, the most favored site being just below the vent, but head, neck, legs, and body may show the presence of these lice.

The shaft louse, the wing louse, and three other less common species are not so serious a menace to chickens.

LICE ON TURKEYS

Four species of lice are found on turkeys; two of these are species which also occur on chickens, whereas the other two are restricted to the turkey. The common body louse of chickens may cause considerable irritation to both young and grown turkeys; the shaft louse of chickens may be present, without evident bad effect. The two species which are found on turkeys only, the large louse, *Goniodes stylifer*, and the slender turkey louse, *Lipeurus polytrapezius*, may be markedly injurious to poult and may cause severe annoyance to adult birds.

LICE ON DUCKS AND GEESE

Young ducks which are hatched by hens may suffer from the head louse of chickens. There are also at least three species of lice which are restricted to ducks and geese, but they are seldom present in sufficient numbers to cause noticeable annoyance.

³ Farmers' Bulletin 801 contains more detailed information regarding lice and their control.

LICE ON PIGEONS

There are two species of lice, different from those found on other domestic birds, which cause considerable annoyance both to old birds and to partially feathered squabs.

LICE POWDERS AND THEIR APPLICATION

Experiments by the Bureau of Entomology have shown that a very satisfactory way of eliminating lice from poultry is to treat each fowl separately with sodium fluoride. If applied to all fowls as directed, one treatment is sufficient to kill all lice and their eggs. Commercial sodium fluoride may be purchased at most drug stores at from 30 to 60 cents a pound and may be applied either by the so-called "pinch" method or by means of a duster made by punching small nail holes in the bottom of a can having a tight-fitting cover, or by dipping. If the pinch method is used, the bird is held on a table while sodium fluoride is applied next to the skin under the feathers, as follows: One pinch under the head, one on the neck, two on the back, one on the breast, one below the vent, one on the tail, one on each thigh, and one on the under side of each wing. The feathers should be ruffled to allow the powder to get next to the skin. If the bird is held in a large, shallow pan, the small quantity of powder which falls off will be saved. If the powder is dusted on by means of a shaker the quantity of sodium fluoride used may be reduced by using 3 parts of road dust or flour to 1 part of the chemical. This method requires the services of a second person to hold and turn the fowl.

When considerable numbers of birds are to be treated the sodium fluoride should be used in the form of a dip, using 1 ounce of commercial sodium fluoride to each gallon of water. The birds should be held by the wings and plunged into a tub full of the solution, leaving the head out, while the feathers are ruffled with the hand to allow the solution to penetrate to the skin. The head is then ducked once or twice and the bird held for a few seconds to drain, and then released. Dipping is just as effective as the other methods and is quicker and more economical of material. Dipping should be done only on warm, sunny days.

For sick fowls or for very young chickens or turkeys, sodium fluoride should be applied only by the pinch method, and especially in the case of young birds it should be used cautiously, in very small pinches.

One pound of sodium fluoride will treat 100 birds by the pinch method. Figuring a person's time at 40 cents an hour and the drug at 40 cents a pound, it has been estimated that it costs about \$2 to treat 100 fowls. The cost of treatment by dipping is about one-half of this amount and the irritating effect of the powder on the operator is avoided.

Another good lice powder is flowers of sulphur, which should be applied with a duster. Although sulphur is considerably cheaper than sodium fluoride, it is less effective against lice and hence must be applied more liberally, so that its use is in reality more expensive than sodium fluoride. Many other powders, most of which contain pyrethrum (insect powder), are commonly used, but they have no advantage over sodium fluoride.

Dust baths containing a mixture of tobacco dust or other insecticides and ordinary road dust are often recommended to destroy lice. While it is a good plan to let the birds dust themselves when they wish, no method which allows the bird to treat itself for lice can be expected to eradicate them all, since fowls can not get the dusting powder on all parts of the body where lice are, and many lousy birds will not use the dust baths.

A simple procedure which is effective in controlling lice but will not eradicate them consists in the application of undiluted 40 per cent solution of nicotine sulphate to the top surface of the roosts by means of a paintbrush. This is done a short time (from 15 to 20 minutes) before the fowls go to roost. The fumes of the nicotine kill the lice during the first, second, and third nights after application. The head lice, naturally, are least affected. As some of the lice are not killed and the eggs are not destroyed, it is necessary to repeat the treatment frequently.

It is possible and practicable to keep a flock of poultry absolutely free from lice and mites, and this should be the aim of everyone who is endeavoring to establish a successful poultry flock.

MITES⁴

COMMON RED MITE

While there are many kinds of mites affecting poultry, there are three which are of special importance to poultry raisers, the best known being the common chicken mite or red mite (*Dermanyssus gallinae*). In the Northern States this mite is dormant in winter, except in chicken houses which are heated, but in the South it breeds and is active the year round, although it is always most abundant in summer. Unlike the other mites affecting poultry, this parasite, with few exceptions, is found on the birds only when it is feeding. (Fig. 25.) It is nocturnal in habits, feeding at night and hiding during the day in the cracks of the roosts, in the nests, in the corners of the floor, or between boards. For this reason its presence often remains undetected until the chicken houses are badly infested and the poultry raiser seeks an explanation for the drooping condition and listlessness of his fowls.

Treatment.—To eradicate the pest a thorough cleaning of the chicken houses and spraying with a suitable insecticide having a sufficient body is all that is necessary. All roosts, loose boards, and boxes should be removed and the insecticide applied in the form of a rather coarse spray, using a suitable pump. One of the best substances for the purpose is anthracene oil. As this is a little too heavy to spray well, it may be thinned with an equal quantity of kerosene, or the undiluted material may be applied with a brush to the roosts, roost supports, nest boxes, and other places where the mites are found. High-grade creosote also gives satisfactory results. Crude petroleum is nearly as effective and is usually cheaper. It should be thinned by adding one part of kerosene to four parts of crude oil. Pure kerosene, kerosene emulsion, and carbolic acid, when brought into contact with the mites, will kill them, but as they all lack sufficient body for persistence the spraying must be repeated several times, making the use of these materials impracticable. The coal-tar dips, used in a slightly stronger solution than recommended

⁴ For further information on poultry mites consult Farmers' Bulletin 801.

on the labels, will be effective if the application is repeated, and the germicidal properties are a desirable feature. Whatever preparation is used, the birds should be kept out of the houses until the fluid has thoroughly soaked into the wood.

DEPLUMING SCABIES

Fowls and pigeons are sometimes infested by an itch mite, *Oncenidocoptes gallinae*, which lives at the base of the feathers, causing an intense itching and producing a disease known as mange or depluming scabies. The irritation caused by the mites leads the fowls to pull out their feathers, and they often acquire the habit

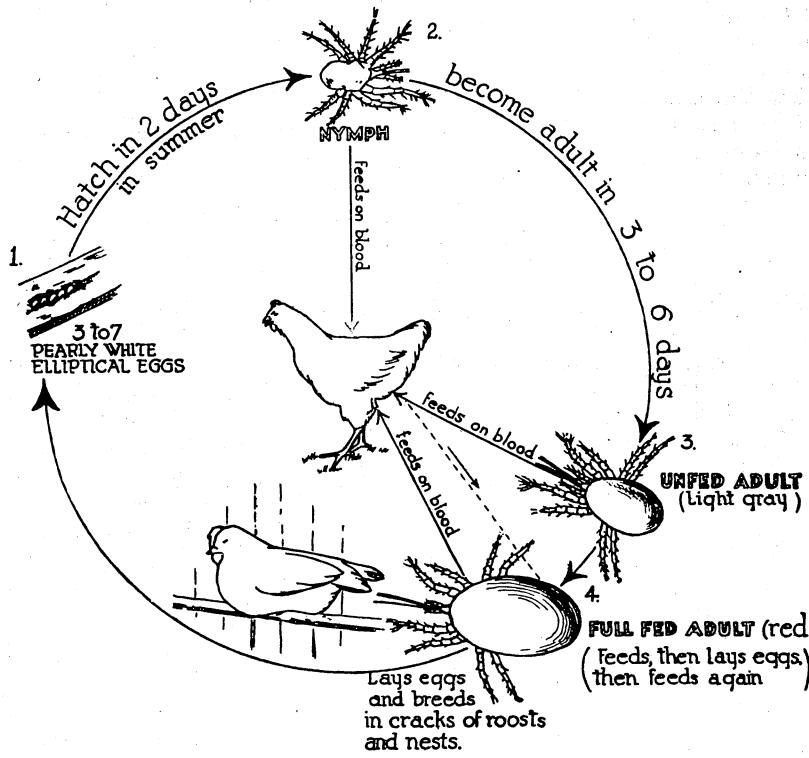


FIGURE 25.—Diagram showing the life habits of the common chicken mite

of feather pulling, attacking the plumage of other birds as well as their own. If the stumps of the feathers are examined soon after the breaking of the quill, they will be found surrounded by scales and crusts, and the adjoining feathers when pulled out will be found similarly affected. In this way the condition can easily be distinguished from molting or the vice of feather pulling, which fowls sometimes acquire without apparent cause. The mites causing the disease are introduced into the poultry yard by affected fowls and spread rapidly from fowl to fowl, finally infesting nearly all in the flock. The disease usually begins in the spring, is most active in warm weather, and largely disappears in winter.

Treatment.—Complete control may be effected by dipping the entire flock in a tub of water containing 2 ounces of flowers of sulphur

and one-half ounce of laundry soap to each gallon of water. If the fowls are also infested with lice, the two pests may be eliminated with a single treatment by dipping in this mixture, to which has been added three-fourths of an ounce of commercial sodium fluoride. As the depluming mite is well protected by the skin scales, it is necessary to soak the fowls thoroughly to destroy all the mites. As a soapy mixture of this kind completely wets the plumage, special care must be taken to do the dipping on a warm day when there is little wind. When the infestation is limited to a few birds, or when for other reasons it is not desired to treat the whole flock, the trouble may be held in check by applying to the affected parts an ointment made by thoroughly mixing 1 part of flowers of sulphur with 4 parts of vaseline or lard.

THE FEATHER MITE

Infestations of the feather mite, *Liponyssus silvarum*, have occurred in many flocks during the last few years; it is very injurious in the northern part of the United States. This mite closely resembles the common chicken mite, but has very different habits in that it breeds among the feathers. The eggs are deposited and hatch among the feathers where the young mites may complete their entire development without leaving the fowl. These mites are to be found in greatest numbers below the vent, about the tail, and sometimes on the neck. The feathers often have a dirty appearance from the presence of the mites and the skin may be irritated and scabby from the bloodsucking habits of the parasites. The feather mite may first be detected on the hens' eggs, their presence there in large numbers being said to be a characteristic sign of infestation with this mite. These mites have been found in the nests of English sparrows near infested chicken houses.

Treatment.—Feather mites may be destroyed by dipping affected fowls in a tub containing a mixture of water, 1 gallon; flowers of sulphur, 2 ounces; and soap, 1 ounce.

The feathers should be thoroughly wet to the skin. The head should be submerged for an instant. During the dipping process the mixture should be stirred so as to keep the sulphur in suspension. Dipping should be done only on warm, sunny days, or in a heated building. If treatment is found to be necessary during the winter or early spring months thorough dusting of the fowls with flowers of sulphur should take the place of dipping.

The nesting material should be removed and burned, and nest boxes, roosts, walls, and floor should be sprayed or painted with anthracene oil as recommended for use against the common chicken mite.

A simpler method than the one just mentioned, reported as satisfactory in some cases but not so successful in others, consists in painting the perches with a 40 per cent nicotine-sulphate solution shortly before the fowls go to roost, and dusting the nests with sulphur. Nests of English sparrows in the immediate vicinity of the poultry house should be destroyed.⁵

⁵ For further information regarding this mite see Department Circular 79, Tropical Fowl Mite in the United States, with Notes on Life History and Control.

SCALY LEG; MANGE OF THE LEG

Another species of itch mite, *Cnemidocoptes mutans*, attacking chickens, turkeys, pheasants, and cage birds, is the cause of a condition known as scaly leg. While this mite is usually confined to the legs, it may occasionally attack the comb and wattles. The disease occurs in most cases as a result of association with infested birds. It spreads slowly, and many individuals escape it entirely, although constantly exposed to it. (Fig. 26.)

Symptoms.—The disease is easily recognized by the enlargement of the feet and legs and the rough appearance of the surface of the feet. The parasite begins its attack in the clefts between the toes and gradually spreads forward and upward until the whole of the foot and the shank become affected. The two legs are usually attacked about the same time and to the same degree. At first there is only a slight roughening of the surface, but the continued irritation by the mite causes the formation of a spongy or powdery substance beneath the scales, which raises them more and more until they are nearly perpendicular to the surface and are easily detached. In the most severe cases the joints become inflamed, the birds are lame and scarcely able to walk, a joint or an entire toe may be lost, and the birds, unable to scratch for feed, lose flesh and die from hunger and exhaustion.

Treatment.—The most effective treatment for scaly leg is to dip the feet and shanks of the infested birds in crude petroleum. This can be done most easily by putting the petroleum in a large bucket or tub. In dipping the feet, care should be taken not to get the oil on the upper part of the legs or on the feathers. If a large number of fowls are to be treated, it is best to do the work in the morning. This gives an opportunity for the oil to dry in and evaporate before the fowls go to roost. Another treatment which has its advocates but is more laborious is to wash the feet and legs with soap and warm water, removing all loose scales. Dry the legs and apply an ointment containing 2 per cent carbolic acid or 15 per cent fine sulphur, or a mixture of Peruvian balsam, 1 ounce, and alcohol, 3 ounces. When crude petroleum is not readily available, kerosene oil may be used as a dip for the feet. With the crude-oil treatment, usually one application is sufficient, although in severe cases a second application 30 days later may be desirable. With the other remedies mentioned, a second treatment should be given 3 or 4 days after the first. To prevent the spread of the scaly-leg mites from fowl to fowl it is advisable to apply anthracene oil or crude petroleum to the roosts.



FIGURE 26.—Scaly leg

OTHER MITES

Several other species of mites infest poultry. One species bores into the skin and is found in cysts lying on the under surface of the skin next to the muscles. This form is not known to do any serious injury. Still another species occurs in the air passages, liver, and lungs of chickens. Unless present in sufficient numbers to interfere with breathing, it is not a serious pest. Still other mites live among the feathers of the birds, sometimes causing an unsightly appearance of the feathers, but apparently cause little injury to the birds themselves.

CHIGGERS, OR HARVEST MITES

Chiggers, harvest mites, or "red bugs," which so frequently annoy campers by the intense itching they produce, may also attack fowls. Young chickens having a free range, especially if it includes low-lying lands, are the most likely to suffer from these parasites. The mites attach to the skin, causing an intense itching, and abscesses may be found where clusters of mites are feeding. These abscesses are sometimes a third of an inch in diameter, surrounded by an area of inflammation. The birds become droopy, refuse to eat, and may die from hunger and exhaustion.

Treatment.—If an abscess has not yet formed, the inflamed area may be treated with sulphur ointment, Peruvian balsam, or a mixture of 1 part of kerosene with 3 parts of lard. If suppuration has occurred the scab should be removed and the area washed with 4 per cent carbolic-acid solution. Frequent light dusting with flowers of sulphur will keep the chickens from becoming infested. In the Southern and Central States, where harvest mites are most numerous, it is often necessary to keep young chickens off the range in summer. In these sections it is a good plan to hatch the chicks early in the spring, so that when the warm weather comes, in which the mites are most abundant, the birds will be old enough to resist their attacks.

TICKS*

In some parts of the South poultry are commonly infested with a species of tick known as the chicken tick or bluebug, *Argas miniatus*. This parasite when full grown may be from one-fifth to one-fourth of an inch long and is a powerful bloodsucker. In its adult stage of development it has feeding habits similar to the much smaller red mite, in that it feeds only at night and spends the days hiding in cracks in the roosts or walls. Pigeons are occasionally attacked by a similar tick, and both species have been known to inflict painful bites on persons coming in contact with infested birds. These ticks, on account of their relatively large size as compared with mites, can do a great deal of damage in a poultry or pigeon house, and young birds attacked by them are liable to succumb from loss of blood. Moreover, in the case of the chicken tick, it is known that in some countries this parasite may itself be parasitized by minute organisms which are injected into the blood of the fowl which it attacks, causing a severe and usually fatal fever. In this way the tick acts as a carrier of the disease organism much as the mosquito by its bites carries the organism causing malaria in man.

The first stage of the chicken tick's development is passed on the body, the seed tick leaving the birds when it has become engorged;

* For additional details see Farmers' Bulletin 1070, The Fowl Tick and How Premises May Be Freed from It.

thereafter the adult tick attacks chickens only at night, after they have gone to roost.

Treatment.—Chicken ticks are very persistent, and ordinary insecticides have little effect on them. If the chicken house is badly infested and is not of much value, it should be destroyed by burning. Otherwise, it may be disinfected after all loose boards and boxes which may provide hiding places for the ticks have been removed. Then anthracene oil, crude petroleum, or wood preservative may be applied as recommended for the treatment of red mites. After the general spraying it is usually necessary to apply anthracene oil to the roosts, roost supports, and nests several times at intervals of three or four weeks.

A simple and inexpensive way of protecting chickens from the attacks of ticks is to provide readily demountable roosts direct from the floor and not touching the walls. These should be painted occasionally with anthracene oil or petroleum. Nests should be located away from roosting places. If constructed of metal they can be quickly rid of ticks from time to time by burning out the straw.

Metal houses have been found to be effective in dealing with the ticks, as even without special attention they remain practically tick free, and if necessary they can be disinfected easily by a fire of straw, paper, or other light material, after removal of the roosts. Metal houses, however, are usually more expensive than wooden ones, and are hot in summer and cold in winter. If they are used in summer the fowls should be provided with shade outside the house.

When ticks have once been eradicated from the premises no chickens should be added to the flock until they have been quarantined for 10 days in temporary coops. The coops should be destroyed after use, or thoroughly treated with anthracene oil.

FLEAS¹

In the Southern and Southwestern States poultry are frequently infested by a species of flea known as the chicken flea (fig. 27), or sticktight flea, so called from its habit of remaining attached to one place. This form also attacks dogs, cats, and some wild animals. On poultry the fleas are usually found in clusters on the comb, wattles, and around the eyes; on dogs they are found on the ears. Young fowls when heavily infested often die quickly. Older birds, while more resistant, have been known to succumb to heavy infestations, and even mild infestations reduce egg laying and retard growth.

Treatment.—As a preliminary step in the treatment of fleas, all dogs and cats should be kept away from the chickens and should never be allowed to lie on the ground in the chicken yards. As rats frequently harbor large numbers of these fleas and may therefore keep up the infestation, they should be destroyed by trapping, not only on account of the fleas they may carry but because they are themselves a serious pest to poultry. Chicken fleas breed in the dust on the floors of henhouses, and on the soil under houses and outbuildings. Hence especial attention must be given to the treatment of the breeding places rather than of the infested fowls. The combs and wattles of the birds may be anointed with carbolated petrolatum

¹For additional details in regard to chicken fleas see Farmers' Bulletin 897, Fleas as Pests to Man and Animals, with Suggestions for Their Control.

or sulphur ointment. Great care should be taken, however, not to get any of the ointment in the birds' eyes, as it may produce blindness. The henhouses and yards should be thoroughly cleaned and sprayed with creosote oil. As the fleas breed freely in the dust beneath buildings, it is advisable to exclude poultry and animals from such places.

THE BEDBUG AND CLOSELY RELATED BUGS

The common bedbug, *Cimex lectularius*, and one of its close relatives, the Mexican chicken bug, *Haematosiphon inodora*, as well as the European pigeon bug, *Cimex columbarius*, and the barn-swallow bug, *Oeciacus hirundinis*, may attack domestic birds and may become serious pests. The bugs live in the nests or about roosting places, hiding in the cracks during the day and coming out at night to suck the blood of the fowls.

They especially annoy sitting hens, sometimes causing them to desert their nests. Since they may gain entrance to houses and cause much annoyance to human beings, their control is doubly important.

Treatment.—These pests can usually be destroyed by the thorough spraying of all cracks of the poultry house with creosote oil or crude petroleum.⁸ Poultry houses should be built so as to eliminate, so far as possible, holes and cracks which offer protection to the bugs.

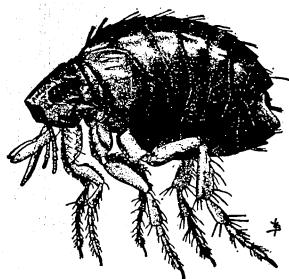


FIGURE 27.—The sticktight flea, adult female. Much enlarged

BEETLE LARVAE

There are several different kinds of beetle larvae which may occasionally attack domestic birds. Young pigeons especially suffer from such attacks. The larder beetle, *Dermestes lardarius*, and also the meal worm, *Tenebrio molitor*, have been known to kill squabs by eating away the skin at the vent and neck, thus producing serious sores; and larvae of one of the sexton or burrowing beetles, *Necrophorus* sp., may also attack these young birds. The adult of the meal worm, on the other hand, may greatly annoy sitting hens, attacking them on the feet. In addition, larvae of the blowflies, *Lucilia* spp. and *Cochliomyia macellaria*, may be found on domestic birds, the eggs having been deposited by the fly in sores or in the natural openings of the bird's body.

THE PIGEON FLY

In recent years the pigeon fly, *Pseudolynchia maura*, has become a serious menace in many parts of the United States, especially in the Southern States. The flies annoy the pigeons and, when numerous, their bites cause considerable loss of blood; in addition, they transmit the organisms which cause pigeon malaria. See page 40 for details in this connection and for control measures.

⁸For additional details in regard to the bedbug and its control see Farmers' Bulletin 754, The Bedbug.